NATURE

CUk-H06840-10-P2038

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

10

VOLUME X.

MAY 1874 to OCTOBER 1874

652.026

> *"To the solid ground*
> *Of Nature trusts the mind that builds for aye."*—WORDSWORTH

London and New York:
MACMILLAN AND CO.
1874

P20348

LONDON
R. CLAY, SONS, AND TAYLOR, PRINTERS
BREAD STREET HILL

INDEX

Aberdeen, Cryptogamic Show, 427, 447
Abney (Capt. R. E.), Photographic Operations in Transit of Venus, 449; Photographic Irradiation, 522
Acclimatisation Societies: Paris, 473, 514; Victoria, 380
Action of the Horse, 39
Aeronautical Experiments (*See* Balloons)
Aeronautical Society, 448
Africa: Lieut. Cameron's Expedition, 172, 214, 231; Expedition to investigate the Slave Trade, 195; Col. Gordon's Expedition to Gondokoro, 72, 295; Berlin Exploration Society, 134, 383, 512; Natural History Notes from South Africa, 486; Eclipse of 1874, 59
Agriculture: Baldwin's "Irish Farming," 203; "Sewage and Sewage Farming," 381; Technology of Agriculture, 307; Application of the Laws of Selection, 350; Utilisation of Sewage, 431; R. Jeffries on "Small Farms," 529
"Agriculture and Geology," by Amédée Burat, 458
Agricultural Schools, 15
Agricultural Society of Scotland, 151
Agricultural Shows: Science in the Showyard, 199
Airy (Hubert), Pollen-grains in the Air, 355, 398
Aitken (John), Photographic Irradiation, 105, 205, 222, 245, 381, 439, 522
Alga from Jersey (Br. A.), 433
Algeria: proposed Artificial Inland Sea, 231
Allman (Prof. G. J., F.R.S.), a New Order of Hydrozoa, 251
Amber in North America, 277
America: Association for the Advancement of Science; Meeting at Hartford, Connecticut, 194, 382, 441, 463; Exploration in Colorado and New Mexico, 308; Fisheries of New York, 214; Jasper's "Birds of North America," 212; Lobster Breeding, 214; Observatories: at West Point, 208; Annapolis, 209; Survey of Lakes, 35; Telegraphic Clocks, 308; National Academy of Science, 45; Weather Maps, 295, 460
American Journal of Science, 95
American Oyster Trade, 290
Ampelideæ, Indian (Br. A.), 433.
Anagram, Scientific, by Huyghens, 480
Anatomy (*See* British Association, Sec. D)
Anderson (James S.), Aurora, 522
André (C. and G. Rayet), "Practical Astronomy," 42
Andrews (Dr., F.R.S.), High Pressures (Br. A.), 389; Phenomenon in Boring a Well (Br. A.), 432
Andrews (Prof. T., F.R.S.), De Boisbaudran on "Spectres Lumineux," 396
Anemometer for Wind on the Coast (Br. A.), 450
Angora Goat, 448
ngström (Prof. A. J.), Spectrum of Aurora Borealis, 210; Obituary Notice of, 376
Animal Mechanism," by E. J. Marey, 498, 516
nimals: the Hypothesis that they are Automata, and its History, by Prof. Huxley, F.R.S. (Br. A.), 362, 438, 502, 520
ustie (F. E., M.D., F.R.C.P.), Obituary Notice of, 398; Memorial to, 467
nt-eater, Tongue of the (Br. A.), 413
nthropological Institute, 19, 57, 98, 138, 177, 217
nthropological Societies: Gottingen, 350; Paris, 276, 297, 513, 533
nthropology: Aboriginal "Murri" Race of Australia, 521; Col. Lane Fox's Collection, 232; International Congress at Stockholm, 307, 332 (*See* British Association, Sec. D)
Antrim, County, Volcanic Phenomena of (Br. A.), 324
Antwerp, International Horticultural Exhibition, 471
A priori Physical Axioms (*See* Physical Axioms)
Aquarium Cars on Steam Ships, 530
Aquariums: Bridlington (proposed), 152; Crystal Palace, 428, 447; Herne Bay (proposed), 307; Manchester, 74, 93, 172, 275, 428; Southport, 384; Westminster, 230; Marine Aquarium for Inland Students, 260; Seaweed in, 530
Archæological Association, Meeting at Bristol, 231, 273
"Arctic Continent and Polar Sea," by Dr. J. Chavanne, 231
Arctic Exploration, 54, 213, 273, 294, 361, 383, 428, 439
Argentine Republic, Observatory at Cordoba, 72
Argyll (His Grace the Duke of), Flight of Birds, 147, 263
Armstrong (Henry E., Ph.D., F.C.S.), "Organic Chemistry," 333; Isomeric Cresols (Br. A.), 431
Artisans' Institute, 383
Assyria, Mr. Geo. Smith's Expedition, 134
Astronomical Society, 37, 158, 190
Astronomy: Bibliography of, 508; German Astronomical Society, 74
"Astronomy, Practical," by André and Rayet, 42
Astronomy (*See* British Association, Sec. A, and Observatories)
Atmospheric Currents in the West Indies, 65
Atoms and Molecules Spectroscopically Considered, by J. N. Lockyer, F.R.S., 69, 89
Atoms, Theory of, by M. Wurtz, 345
Aurora Borealis, 210, 355, 398, 460, 500, 522
Australia: Leichardt's Exploring Expedition, 15; Major Warburton's Expedition, 53; Sydney Museum, 81; Poisonous Snakes, 273; Angora Goats, 448; Aboriginal "Murri" Race, 521
Austrian Polar Expedition, 273, 383, 428, 439, 523
Automatism of Animals, 362, 438, 502, 520
Axioms, *à priori* (*See* Physical Axioms)

Babington (C. E., M.A., F.R.S.), "Manual of Botany," 242
Backhouse (T. W.), Curious Rainbow, 437
Baird (Spencer F.), "Annual Record of Science," 122; "Fisheries of New England," 201
Baker (Sir Samuel), Rede Lecture, 53
Balding (A.), Meteor at Wisbech, 483
Baldwin (Prof. Thos., M.R.I.A.), "Irish Farming," 203; "Sewage and Sewage Farming," 381
Balfour (Mr.), Development of Sharks (Br. A.), 413
Ball (R. LL.D., F.R.S.), Royal Astronomer of Ireland, 14
Balloon Ascents: from Odessa, 94; by M. de Fonvielle, 195; Fatal Experiment of M. de Groof, the "Flying Man," 230; Experiment at Woolwich, 230, 252, 285, 461; Ascents in New York and Canada, 344; Paris, 360
"Barbadoes, Rainfall of," by Governor Rawson, C.B., 241
Barker (Lady), "Lessons on Cooking," 283
Barrett (Prof. W. F.), Sounding and Sensitive Flames, 244
Barrows, Chambered, 290
Bastian (Dr. H. C.), his Experiments on Bacteria, 4
Bath, Natural History Club, 174
Beaumont (M. Elie de), Obituary Notices of, 447, 471
Becquerel (Edm.), Researches in Photography, 281
Bee-keepers' Association, 114, 383
Bees feeding on Larvæ, 31
Belfast: Meeting of the British Association (*See* British Association); Naturalists' Field Club, 361
Belgium, Royal Academy of Sciences, 15, 76, 235, 252
Bell (Lowthian, F.R.S.), Action of Carbonic Acid and Cyanogen on Oxide of Iron (Br. A.), 390
Belt (Thos., F.G.S.), The Glacial Period, 25, 62, 85, 105
Benger (F. Baden), Cry of the Frog, 483
Bennett (Alfred W., F.L.S.), Fertilisation of Labiatæ, 92; Specimens and Apparatus at the Br. A., 380; Pollen-grains in the Air (Br. A.), 398, 433
Bentham (G. F.R.S.), Systematic Botany (Br. A.), 433

Berlin: African Exploration Society, 134, 383; German Chemical Society, 198
Berwickshire Naturalists' Club, 330
Bethnal Green Museum, Col. Lane Fox's Anthropological Collection, 232
Bettany (G. T.), Biology at Cambridge, 53
Bezold (Prof. W. von), "The Science of Painting," 221
Bibliography of Science, 508
Binz (Prof.), Hay Fever, 26
Biology: at Cambridge, 53; Bibliography of, 508 (*See* British Association, Sec. D)
Birch (Dr. Samuel), International Congress of Orientalists, 419
Birds, Boddaert's Catalogue of, 123
Birds, Flight of, 147, 263, 518
Birds, Flowers destroyed by, 6, 24
"Birds in the British Museum," Catalogue by R. Bowdler Sharpe, 195, 378
Birds, Migration of, 415, 459, 520
"Birds of North America," by Dr. Theodore Jasper, 212
Birkbeck Literary and Scientific Institution, 252, 511
Birmingham: Proposed Aquarium, 93; Free Library, 93; Statue of Dr. Priestley, 213
Birmingham and Midland Institute, 407
Blackburn (Joseph), Supernumerary Rainbows, 503
Blood, Transfusion of, 173
Boddaert's Catalogue of Birds, 123
Boisbaudran (Lecoq de), "Spectres Lumineux," 396
Bonney (Rev. T. G.), The Glacial Period, 44, 62, 85, 105
Borrelly's Comet, 267, 287, 336
Boston (U.S.), Society of Natural History, 78, 118, 277
Botanical Congress at Florence, 74
Botanico-Geological Excursion into the Grampians, 90
Botany: "Natural Orders of the Vegetable Kingdom," by Prof. Oliver, F.R.S., 222; "Manual of British Botany," by C. C. Babington, M A., F.R.S., 242; Respiration and Nutrition in Plants, 427; Systematic Botany (Br. A.), 433; "Flora of Dorsetshire;" "Flora of Settle in Craven," 459; Bibliography of Botany, 510 (*See* British Association, Sec. D)
Boulder Committee of Br. A, Report, 388
Boulger (G. S.), Colour in Flowers not due to Insects, 520
Braham (Philip, F.C.S.), Experiments on Light (Br. A.), 389
Braham and Gatehouse (Messrs.), Dissociation of Nitric Acid (Br. A.), 452
Brain (The), Localisation of its Functions, by Dr. Brown-Séquard, 45, 245, 250
Brain (The) and Auditory Capsule (Br. A.), 412
Breslau: Population and Health, 154, 236; Scientific Congress, 416
Bridlington: Proposed Aquarium, 152; "Crag" Beds (Br. A.), 412
Bristol College of Science and Literature, 93, 134
BRITISH ASSOCIATION: Meeting at Belfast—Preliminary Arrangements, 193, 230, 293; Officers of Sections, 194, 230; Room for Specimens and Apparatus, 263, 380; Inaugural Address by Prof. Tyndall, D.C.L, F.R.S., President, 309; Financial Statement, 336; Recommendations of the Committee, Grants, 361. Reports—Rainfall (1873–74), 342, Dredging, Coast of Durham and North Yorkshire, 343; Mathematical Tables, 372; Nomenclature of Dynamical and Electrical Units, 372; Siemens' Pyrometer, 372; Tables of Wave Numbers, 373; Sub-Wealden Exploration, 273; Influence of Forests on Rain, 373; Thermal Conductivities of Rocks, 386; Progress of Chemistry, 387; Exploration of Victoria Cave, Settle, 387; Boulder Committee, 388; Close Time Committee, 388; Teaching of Physics in Schools, 410; Luminous Meteors, 430; Isomeric Cresols, 431; Utilisation of Sewage, 431; Classification of Labyrinthodonts, 449
  Section A (*Mathematical and Physical Science*).—Officers, 194; Opening Address by the Rev. Prof. J. H. Jellett, M.A., M.R.I.A, 319; Grants, 361; Perturbations of the Compass by the Rolling of the Ship, by Sir Wm. Thomson, 388; Spectrum of Coggia's Comet, by Dr. Huggins; Experiments on Light, by P. Braham, F.C.S., 389; Kirchhoff's Rules for Electric Circuits, by Prof. Clerk-Maxwell, F.R.S.; Sun-spot and Atmospheric Ozone, by T. Moffatt, M.D.; Charts on Gnomonic Projection, by J. G Morrison, 411; Construction of a perfectly Achromatic Telescope, by Prof. G. G. Stokes; Periodicity of Cyclones, Rainfall, and Sun-spots, by C. Meldrum, 431; Photographic Operations in Transit of Venus, by Capt. Abney, R.E, 449; Anemometer for Wind on the Coast, by Dr. De la Rue, F.R.S., 450; Kinetic Energy, by J. Purser, M.R.I.A., 450; Nicol's Prisms, by W. Ladd, 451
  Section B (*Chemical Science*).—Officers, 194; Opening Address by Prof. A. Crum Brown, M.D., F.R.S.E., F.C.S., 337; Grants, 361; Chemical Composition of Jute Fibre, by Prof. Hodges; High Pressures, by Dr. Andrews, F.R.S.; Latent Heat of Liquefied Gases, by J. Dewar, F.R.S.E.; Spontaneous Generation, by Dr. Debus, F.R S.; Phosphoric Acid, by Mr. Ogilvie, 389; Improved Filter Pump, by W. Jesse Lovett; Sulphur-Urea, by Prof. Emerson Reynolds; Action of Carbonic Acid and Cyanogen on Oxide of Iron, by Lowthian Bell, F.R.S.; Electrotypic Experiments on Metallic Chlorides, by Dr. Gladstone, F R.S., and Mr. Tribe; Composition of certain kinds of Food, by W. J. Cooper, 390; Opium Derivations, by Dr. Wright; Phenomenon in Boring a Well, by Dr. Andrews; Reaction of Hydrogen, Peroxide, &c., by Mr. Fairley, General Equations of Chemical Decompositon, by Prof. Clifford, F.R.S.; Cyanogen in Commercial Bromine, by Dr. T. L. Phipson; Sesqui-Sulphide of Iron, by Dr. Phipson; Chlor.-Bromides and Brom-Iodides of the Olefines, by Prof. Maxwell Simpson, F.R.S., 432; Specific Volumes of Liquids, by Prof. Thorpe; Dissociation of Nitric Acid, by Messrs. Braham and Gatehouse; Process of Fossilisation, by Dr. Carpenter, F.R.S.; Abnormal Chlorides, by Prof. Roscoe, F.R.S., 452
  Section C (*Geology*).—Officers, 194; Opening Address by Prof. Edw. Hull, F.R.S., 324; Grants, 361; Silicified Wood from the Rocky Mountains, 390; Microzoa in Chalk Flints, by Jos. Wright; Polyzoa from Silurian Rocks, by Prof. H. A. Nicholson; "Crag" Bed of Bridlington, by J. Gwyn Jeffreys, F.R.S., 412; Tyrone Coal-field, by Mr. Hardman, 432
  Section D (*Biology*).—Officers, 194; Opening Address by Prof. Peter Redfern, M.D., 327; Grants, 361
  Department of Anatomy and Physiology.—Brain and Auditory Capsule, by Prof. Cleland, 412; The Iguanodon, by B. Waterhouse Hawkins; Development of Sharks, by Mr. Balfour; Tongue of the Ant-eater, by Prof. Macalister; *Columella auris* in Amphibia, by Prof. Huxley; the Eye of Cephalopoda, by E. Ray Lankester; Effects of Ozone, by Prof Redfern, 413; Wild Flowers and Insects, by Sir J. Lubbock, Bart., F R.S., 402, 422.
  Department of Zoology and Botany.—British Mollusca, by J. Gwyn Jeffreys, F.R.S.; Distribution of Cassowaries, by P. L. Sclater; Potato Disease, by J. Torbitt; *Eozoon canadense*, by Dr. Carpenter, 390; Alga from Jersey, by Dr. Williams; Indian Ampelideæ, by Prof. Lawson; Tree-ferns, by D. Moore; Mosses of the North of Ireland, by S. A. Stewart; Abnormal Daisy, by Prof. Dickson; Systematic Botany, by G. Bentham, F.R.S.; Pollen-grains, by A. W. Bennett, 433; External Shell of Mollusca, by E. R. Lankester, 452; English Nomenclature in Biology, by E. R. Lankester, 453
  Section E (*Geography*).—Officers, 194; Opening Address by Major Wilson, R. E., 339; Grant to Palestine Exploration Fund, 361
  Section F (*Statistics and Economic Science*).—Officers, 194; Grant, 361
  Section G (*Mechanical Science*).—Officers, 194; Grant for Measuring Speed of Ships, 361; Opening Address by Prof. James Thompson, LL.D., 390
British Museum: Zoological Curatorship, 273; Sharpe's "Catalogue of Birds," 195, 378
Bromide Plates for Photography, 281
Bromine, Commercial, Cyanogen in (Br. A.), 432
Brown (Prof. A. Crum), Opening Address in Sec. B, Br. A. 337
Brown (Robert), and Sprengel, on the Structure of Plants, 161
Brown-Séquard (Dr.), Functions of the Brain, 45
Bruce-Clarke (W.), Palæotherium magnum, 124
Brussels, Royal Academy of Sciences, 407, 434
Burat (Amédée), "Geology and Agriculture," 458
Burnham (S. W.), Lakes with Two Outfalls, 124
Burnley Grammar School, 134
"Butterflies of North America," by W. H. Edwards, 231

Cable-laying, Appliances on board the *Faraday*, 64
Caen Academy of Science, 218

California: Marine Aquarium, 94; Observatory and School of Mechanical Arts, 171
Canary Islands, Fauna of the, 276
Cambridge: Natural Science Club, 16; Science at, 34, 53, 93, 114, 132, 133, 151, 194, 213, 286, 472, 488; New Physical Laboratory, *With Plans*, 139; Strickland Curatorship, 250
Cameron (Lieut.), Livingstone Expedition, 172, 214, 231
Camphor, 8, 16
Canada, Geological Survey, 144
Cape of Good Hope, Catalogue of Stars, 295
Capron (J. Rand), Hay Fever, 63; Aurora Borealis, 460
Carbonic Acid and Cyanogen, their action on Oxide of Iron (Br. A.), 390
Cardiff Naturalists' Society, 472
Carnivorous Habits of Plants, by Dr. Hooker, C.B., President R.S. (Br. A.), 366, 406, 428, 438, 463
Carp, Longevity of, 147, 165
Carpenter (W. B., M.D., F.R.S.), "Principles of Mental Physiology," 40; Ocean Currents, 52, 62, 83, 113; Researches on *Eozoon canadense* (Br. A.), 103, 390; Lenz's Doctrine of Ocean Circulation, 170; Process of Fossilisation (Br. A.), 452; Lectures on Geology, 511
Cassowaries, Distribution of (Br. A.), 390
Cause and Effect, Quantitative Relations of, 43, 84, 103
Cavendish Laboratory, Cambridge, erected by the Duke of Devonshire, 139
Cedar-wood, Natural History collections damaged by, 35
Cephalopoda, The Eye of (Br. A.), 413
Challenger, H.M.S., progress of, 34, 54, 73, 359, 360, 427, 511; Report from Prof. W. Thomson, 142; Botany of the Expedition, by H. N. Moseley, 165; Deep-sea Temperatures, 254
Charts on Gnomonic Projection (Br. A.), 411
Channel Tunnel to France, proposed, 181
Chemical Decomposition, General Equations of (Br. A.), 432
Chemical Society, 35, 37, 77, 117, 153, 157, 215, 275, 532
Chemical Society's Journal, 115, 472
Chemistry: Bibliography of, 508; Memoir of Joseph Priestley, 239; Monthly Reports of Progress (Br. A.), 387; "Organic Chemistry," by H. E. Armstrong, Ph.D., F.C.S., 333 (*See* British Association, Sec. B)
Children of Different Races, their Mental Potentiality, 272
China: Camphor Trade, 16; Mammals of Moupin, 32
Chisholm (H. W.), International Metric Commission, 130
Chlorides, Abnormal (Br. A.), 452
Chronometers, Uncompensated, 63
Chrysemida Banksii, 355, 419
Cinchona Cultivation in St. Helena, 471
Cincinnati Observatory, 186, 188
Civil Engineers' Institution, 54, 214, 447
Clarke (Hyde), Degeneracy of Man, 163
Cleland (Prof.), Brain and Auditory Capsule (Br. A.), 412
Clerk-Maxwell (Prof. J., F.R.S.), Plateau on Soap-Bubbles, 119; Molecular Motion, 123; Grove's "Correlation of Physical Forces," 302; Kirchhoff's Rules for Electric Circuits (Br. A.), 411; Van der Waals on the "Continuity of the Gaseous and Liquid States," 477; Double Rainbow, 437
Clifford (Prof., F.R.S.), General Equations of Chemical Decomposition (Br. A.), 432
Clocks, Telegraphic, in America, 308
Clockwork, Regular Motion in, 459
Close Time Committee (Br. A.), Report, 388
Clothworkers' Company, Professorship of Textile Industries, 213
Clowes (Frank), Glass Cells with Parallel Sides, 44
Coal: in Japan, 232; Central India, 308; Spitzbergen, 472
Cochrane (Capt. J. D., R.N.), Lakes with Two Outfalls, 124
Cockroach, Salivary Glands of the, 381, 439
Coffee Blight, 177
Coggia's Comet, 56, 113, 132, 149, 179, 184, 191, 212, 226, 252, 273, 287, 294, 336, 389, 534
College for Men and Women, 472
College for Working Women, 488
Collier (Jas.), Quantitative Relations of Cause and Effect, 43; Physical Axioms, 61, 84, 104
Colliery Explosions and the Weather, 157, 224
Colonial Geological Surveys:—I. Canada, 144; II. Victoria, 200
"Colorado, Flora of," 344
Colour in Flowers not due to Insects, 503, 520
Columella auris in Amphibia (Br. A.), 413
Comber (Thos.), Colour in Flowers not due to Insects, 520
Comets: Borrelly's, 252, 267, 287, 336; Coggia's, 56, 113, 132, 149, 179, 184, 191, 212, 226, 252, 273, 287, 294, 389, 534
"Comets and the New Comet of 1874," 397
Comets, The Forms of, by M. Faye, 227, 245, 268, 287
Compass, Perturbations of the, by Ship's Rolling (Br. A.), 388
Competitive Examinations, 416
Connecticut Academy of Arts and Sciences, 273
"Continuity of the Gaseous and Liquid States," by J. D. Van der Waals, 477
Contjean (Ch.), "Eléments de Géologie," 100
"Cooking, Lessons on," by Lady Barker, 283
Coolidge (W. A. B.), Lakes with Two Outfalls, 6
Cooper (W. J.), Composition of certain kinds of Food (Br. A.), 390
Copenhagen Academy of Sciences, 407
"Coral Reefs," by Charles Darwin, F.R.S., 353
Cordoba: Observatory, 72; University, 73
Corfield (Prof.), Utilisation of Sewage (Br. A.), 431
Cornish Sardines, 407
Coronilla, Fertilisation of, 169
Corydalis claviculata, 125
Costa Rica: Geology of, 35; Exploration in, 274
Coues (Dr. Elliot), "Field Ornithology," 146
Croatia, University at, 528
Crofts (W. C.), Photographic Irradiation, 245
Croll (James), Ocean Currents, 52, 62, 83
Crookes' Experiments on Evaporation and Condensation, 174
Crotch (G. R., M.A.), Obituary Notice of, 171
Cryptogamic Show, Aberdeen, 427, 447
Crystal Palace: Shows of Bees, Hives and Honey, 38[illegible]; Aquarium, 428, 447
Cyclones: Bengal, 512; Mauritius, 15; Periodicity of (Br. A.), 431

Daisy, Abnormal (Br. A.), 433
Dajee (Dr. Bhau), Obituary Notice of, 270; Memorial to, 3[illegible]
D'Albertis (Sig. L. M.), his Natural History Collections, 113; Expedition to New Guinea, 511
Dall (W. H.), U.S. Coast Survey, 55; Birds of the Aleutian Islands, 172
Dana (Prof. J. D.), Notes on Darwin's Work on "Coral Reefs," 408
Darwin (Chas., F.R.S.), Primroses destroyed by Birds, 6, 24; Origination of Life, 335; "Structure and Distribution of Coral Reefs," 353, 408
Darwin (Geo.), Science at Cambridge, 286
David (Pêre), Mammals of Moupin, 32
Davis (Dr. J. B.), Ancient Peruvian Skulls, 46, 123
Dawson (Dr. J. W., F.R.S.), *Eozoon canadense*, 103
Debus (Dr., F.R.S.), Spontaneous Generation (Br. A.), 389
De Candolle's proposed "Physiological Groups" of Plants, 191
Deep-sea Dredging on board the *Challenger*, 142
"Deep-sea Exploration," by Jules Girard, 102
Deep-sea Soundings, 131, 356, 484
Deep-sea Temperature, 254
Degeneracy of Man, 146, 163, 204
De la Rue (Dr. W., F.R.S.), Chemical Laboratories, 21; Anemometer for Wind on the Coast (Br. A.), 450
Devonshire (his Grace the Duke of), Cavendish Laboratory, Cambridge, erected at his cost, 139; Scientific Education and Research, 150
Dewar (J., F.R.S.E.), Latent Heat of Liquefied Gases (Br. A.), 389
Dickson (Prof.), Abnormal Daisy (Br. A.), 433
Dionæa muscipula, 107, 127, 428, 463
Diseases, Nomenclature of, 436
Disuse as a Reducing Cause in Species, 164
Dolfuss (Gustave), "Principes de Géologie Transformiste," 100
"Dorsetshire, Flora of," by J. C. Mansell-Pleydell, 459
Draper (Prof. J. W.), Spectrum-Photography and Photo-Chemistry, 244
Dredging, Coast of Durham and North Yorkshire, Report on (Br. A.), 343 (*See* Deep-sea Dredging)
Dresden Zoological Museum, 446
Droseraceæ, 105, 127, 406, 428, 438, 463
Drysdale (J., M.D.), "Protoplasmic Theory of Life," 519
Dublin: Trinity College, 14; Royal Irish Academy, 19; Geographical Society, 94; Obstetrical Society, 343
Dunstable, Science at, 152

Durham University, 113
Dyer (Prof. Thiselton), Fertilisation of Fumariaceæ, 5
Dynamical Units, Report on (Br. A.), 372
"Dynamics, Elementary," by W. G. Wilson, M.A., 204

Earth, The; its Figure in Relation to Geological Inquiry, 165
Earthquakes: Constantinople, 172; Utah, 214; Porto Rico, 360; Sicily, Guatemala, Delhi, Madras, 447; Malta, 512; Ceylon, 529
Earth-Shrinkings, 223
Eassie (W., C.E.), "Sanitary Arrangements of Dwellings," 161
Easter Island, Hieroglyphic Tablets and Sculpture, 399
East Indian Museum, Natural History Collections, 33
Eclipse, African, of 1874, 59
"Eclipses, Past and Future," by the Rev. S. J. Johnson, F.R.A.S., 243
Economic Science (*See* British Association, Sec. F)
Edible Frog, 483, 520
Edinburgh: Spar Caves of the North Bridge, 8; Meteorological Society, 197; Royal Society, 471; University, 16, 172, 273, 343, 446
Edkins (Joseph), Degeneracy of Man, 163, 205
Education in the French Army, 529
Education of Women (*See* Female Education)
Egypt: Stone Implements, Ethnology, 138
Electrical Stimulation of the Brain, 360
Electrical Units, Report on (Br. A), 372
Electricity, Metals Vaporised by, 190, 223
Electrotypic Experiments on Metallic Chlorides (Br. A.), 390
Endowment of Research, 21, 132, 150, 272, 456
Entomological Club, Cambridge (Mass.), 295
Entomological Society, 38, 178, 237
Entomology (*See* British Association, Sec. D, and Insects)
Eozoon canadense, Researches on, 103, 390
Ethnology of Egypt, 138
Etna, Mount, Eruption of, 361, 407, 522
Eucalyptus globulus, 112
Evaporation and Condensation, 174
Everett (Prof. J. D.), Uncompensated Chronometers, 63
Evolution and Zoological Formulation, 465
Examinations, Competitive, 416
Exeter, Albert Memorial Museum, 133
Expansion of substances passing from Fusion to Solidification, 156
"Eye, The Human," by W. Whalley, 243

Fairbairn (Sir Wm., Bart., F.R.S.), Obituary Notice of, 343; Memorial to, 512
Fairley (Mr.), Reaction of Hydrogen, Peroxide, &c. (Br. A.), 432
Falcon's Aviary at the Zoological Gardens, 230
Faraday, The, and her appliances for Cable-laying, 64
Farrer T. H., Fertilisation of *Coronilla*, 169
Faye (M.), The Forms of Comets, 227, 245, 268, 287
Female Education, 16, 33, 173, 195, 395, 437, 446, 472, 488, 529
Ferrier (Dr.), Localisation of the Cerebral Functions, 259
Fertilisation of Flowers by Insects, 592, 129, 169
Festing (Major E. R.), Flowers destroyed by Birds, 6
"Field Ornithology," by Dr. Elliot Coues, 146
Filter Pump, Improved (Br. A.), 390
Fish: Longevity of the Carp, 147, 165; United States Commission on Fisheries, 232; Fisheries of Ireland, 232; of New England, 201; of New York, 214
Fish Guano, 530
Flames, Sounding and Sensitive, 244, 273, 286
Fleming (J. A.), Polarisation of the Aurora, 398
Flight of Birds and Insects, 147, 263, 516, 518
Flint Weapons, 245
Florence, International Botanical Congress, 74
Flowers, Wild, considered in relation to Insects, by Sir J. Lubbock, Bart., F.R.S. (Br. A.), 402, 422
Flowers, their Colour not due to Insects, 503, 520
Flowers Fertilised by Insects (*See* Fertilisation)
Flying Man, The; Fatal Experiment of M. de Groof, 230
Fogs in the Atlantic, 285
Fonvielle (W. de), Balloon Ascents, 16, 115; Death of the "Flying Man," 230; Woolwich Aeronautical Experiment, 285, 461; Meeting of the French Association at Lille, 344, 357
Food, Composition of certain kinds of (Br. A.), 390
"Food and Dietetics," by F. W. Pavy, M.D., 60
Forbes (A. Gruar), "Geographical Exploration," 83
Forbes (Prof. Geo.), Transit of Venus, 11, 27, 49, 66, 86; Uncompensated Chronometers and Photographic Irradiation, 85
Foresite, a new Mineral, 407
Fossilisation, Process of (Br. A.), 452
Fossils in Trap, 398, 419
Foster (Prof. G. C.), Teaching of Physics in Schools (Br. A.), 410; Physics at the University of London, 506, 525
Foster (M., M.D., F.R.S.), "Physiology," 261
Fox (Col. Lane), his Anthropological Collection, 232
Fox (Howard), Mist Bows, 438
Foucault, the Inventor of the Siderostat, 358
France: Association for the Advancement of Science, 286, 344, 357; Provincial Institute, Meeting at Rodez, 426; Meteorology, 515; Observatory on the Puy-de-Dôme, 343 (*And see* Paris)
Freiberg, Mining Academy, 489
Frog, Cry of the, 461, 483
Frog, Edible, 483, 520
Frog Culture, 214
Fumariaceæ, Fertilisation of, 5
Fungus Exhibition at Aberdeen, 427, 447

Galloway (Wm.), Colliery Explosion, 224
Galton (J. C.), Can Land Crabs Live under Water? 439, 482
Garrod (Prof. A. H.), Action of the Horse, 39; Evolution and Zoological Formulation, 465
Gas Lighting, Chronology of, 253
Geikie (Prof. A., F.R.S.), Spar Caves of the North Bridge, Edinburgh, 8; Geology of the Grampians, 91; Memoir of Sir Roderick I. Murchison, 232; Colonial Geological Surveys—I. Canada, 144; II. Victoria, 200
"Geographical Exploration," by A. Gruar Forbes, 83
Geographical Magazine, 75, 116, 216, 296
Geographical Society: Medals, 53; Anniversary, 151
Geography: International Congress at Paris, 267; Bibliography, 509 (*See* British Association, Sec. E)
Geological Magazine, 75, 116, 235, 296, 414, 532
Geology: Bibliography of, 510; Colonial Geological Surveys—I. Canada, 144; II. Victoria, 200; Excursion to the Swiss Alps, 54; Figure of the Earth, 165; "Les Roches," by E. Jannetaz, 500; "Geology and Agriculture," by Amédée Burat, 458; Recent French Works, 100; Geological Society, 37, 77, 116, 152, 176, 236; Geological Society of France, 16; Geologists' Association, 58, 117, 232, 237 (*See* British Association, Sec. C)
German Universities, 529
Gilchrist Education Trust, 272
Gippsland, Physical Character and Resources of, 274
Girard (Jules), "Les Explorations Sous-Marines," 102; "Le Monde Microscopique des Eaux," 500
Glacial Period, The, 25, 44, 62, 85
Gladstone (Dr.), Electrotypic Experiments on Metallic Chlorides (Br. A.), 390
Glaisher (Jas., F.R.S.), Luminous Meteors (Br. A.), 430
Glasgow: Geological Society, 58; Society of Field Naturalists, 116; University, 343
Glass Cells with Parallel Sides, 44
Gold in French Guyana, 134; in Samoa, 522
Gordon (Col.), Journey to Gondokoro, 72, 295
Gottingen: Anthropological Society, 350; Royal Society of Sciences, 278, 330
Gould (Mr.), his work at the Cordoba Observatory, 72
Grampians, The, a Botanico-Geological Excursion, 90
Grant (Robert Edmond, M.D., F.R.S.), Obituary Notice of, 355
Grasshoppers, Ravages of, 344
Gray (Capt. David), Seal Fishery, 85
Gray (Dr. J. E.), Resignation of Zoological Curatorship at British Museum, 273
Gray (Prof. Asa), Robert Brown and Sprengel, 161
Green (A. H., F.G.S.), The Glacial Period, 105
Greenwood (Col. Geo.), Lakes with Two Outfalls, 5; Trees pierced by other Trees, 26
Greenwood (W. H., F.C.S.), "Manual of Metallurgy," 418
Grey (Mrs.), Science of Education (Br. A.), 395

Grove (The Hon. Sir W. R., F.R.S.), "Correlation of Physical Forces," 302
Gunpowder Explosion on the Regent's Canal, 470
Guthrie (Prof. F., LL.B.), Flight of Birds, 147; Herbert Spencer and Physical Axioms, 305

Haarlem Society of Sciences, 401
Hailstorm in Natal, 115
Halford (Dr. G. B.), Poisonous Snakes of Australia, 273
Halifax, Geologists' Field Club, 151
Hardman (Mr.), Tyrone Coal-field (Br. A.), 432
Harley (Dr. George, F.R.S.), International Congress of Anthropology and Archæology at Stockholm, 332
Harrison (J. Park), Hieroglyphic Tablets in Easter Island, 399
Hart (W. E.), Flowers destroyed by Birds, 6; Fertilisation of Flowers, 5, 125
Harvard (U.S.), Museum of Comparative Zoology, 94; Meeting of American Association, 382
Hawkins (B. Waterhouse), Destruction of his Models in the Central Park, New York, 112; The Iguanodon (Br. A.), 413
Hayden (Dr.), Geological Survey, 448
Hay Fever, Experimental Observations on, 26, 63, 172
Hayward (Robt. H.), Mr. Spencer and *à priori* Axioms, 25, 43, 61, 84, 103, 104, 335
Heat, Vibrations of Air produced by, 233
Heat developed by Collision, its Distribution, 400
Helmholtz (Prof. H.), Hay Fever, 172; Memoir of John Tyndall, *With Portrait*, 299
Henry (Prof. Jos.), Endowment of Research, 150
Herne Bay, proposed Aquarium, 307
Herpetology of New Guinea, 191
Herschel (Capt. J., R.E., F.R.S.), Letters of Sir John Herschel, 184
Herschel (Prof. A. S.), Vibrations of Air produced by Heat, 233; Thermal Conductivities of Rocks (Br. A.), 386; Periodicity of Auroras, 500
Hieroglyphic Tablets in Easter Island, 399
Higgins (H. H.), Meteor at Ramhill, 482
High Pressures (Br. A.), 389
Himalayan Mammals, Drawings by Brian Hodgson, F.Z.S., 306
Hind (J. R., F.R.S.), Coggia's and Borrelly's Comets, 113, 132, 149, 191, 252, 267, 287, 336
Hind (Prof. H. Y.), Figure of the Earth in relation to Geological Inquiry, 165; "The Dominion of Canada," 173
Hinton (Jas.), "Physiology for Practical Use," 121
Hitzig (Dr.), Localisation of the Cerebral Functions, 259
Hodges (Prof.), Chemical Composition of Jute Fibre (Br. A.), 389
Hodgson (Brian, F.Z.S.), Drawings of Himalayan Mammals, 306
Holden (Edw. S.), Lakes with Two Outfalls, 124
Holdsworth (E. W. H., F.L.S., F.Z.S.), Maunder's "Treasury of Natural History," 283
Hollis (Dr. W. Ainslie), Pfluger on the Salivary Glands of the Cockroach, 381
Home (D. M.), Agricultural Schools, 15
Honeyman (D.), Fossils in Trap, 398
Hooker (Dr. C. B., Pres. R. S.), Carnivorous Habits of Plants (Br. A.), 366, 438
Hopkins (G. H.), On Vaporising Metals by Electricity, 190; Meteor at Burley, Hants, 419; Carnivorous Plants, 438
Hopkinson (J.), Regular Motion in Clockwork, 459
Horrocks (Jeremiah), Proposed Monument to, 190
Horse, Action of the, 39
Horticultural Society, 77, 117, 138, 177, 258, 277, 297
Howorth (Henry H.), Earth-shrinkings and Terrestrial Magnetism, 223
Huggins (Dr.), Spectrum of Coggia's Comet (Br. A.), 389
Hull (Prof. Edward, F.R.S.), Opening Address, Sec. A, Br. A., 324
Human Mortality and the Seasons of the Year, 210
Hunterian Lectures, 167, 249, 444
Huxley (Prof., F.R.S.), Automatism of Animals (Br. A.), 362, 438; *Columella auris* in Amphibia (Br. A.), 413; Address on opening Medical School at Owens College, 455
Huyghens, Anagram by, 480
Hydrogen, Reaction of (Br. A.), 432
Hydrozoa, a New Order of, 251

Icebergs, 215, 285
Iceland: the Vatna Jokull, 34; Sulphur Mines, 271; Millenary Celebration, 279
Iguanodon, The (Br. A.), 413
India: Coal, 308; Science in, 55, 114, 253, 270
Insects, Brazilian, Habits of, 102
Insects, Useful and Noxious, Exhibition at Paris, 295, 407, 530
Insects, Flight of, 516
Insects, their Influence on the Colour of Flowers, 503, 520
Insects, Wild Flowers in relation to, by Sir J. Lubbock, Bart, F.R.S. (Br. A.), 402, 422
Insects, Fertilisation of Flowers by (*See* Fertilisation)
International Metric Commission at Paris, 130
Ireland: Report on Fisheries, 232; Volcanic Phenomena of County Antrim (Br. A.), 324; Catholic University, 352
"Irish Farming," by T. Baldwin, M.R.I.A, 203
Iron, Sesqui-sulphide of (Br. A.), 432
Iron and Steel Institute, 15, 34, 377
Isomeric Cresols (Br. A.), 431
Italy: Royal Institution of Lombardy, 154, 236; Science in, 253, 257, 297, 473, 512

Jaborandi, a new Drug from Brazil, 34
Jackson (John R.), Camphor, 8; *Eucalyptus globulus* in Mauritius, 112
Jannetaz (Edouard), "Les Roches," 500
Japan: Coal in, 232; Deep-sea Soundings, 356
Jasper (Dr. Theodore), "Birds of North America," 212
Jebb (George R.), Lakes with Two Outfalls, 185
Jefferies (R.), "Small Farms," 529
Jeffreys (J. Gwyn, F.R.S.), British Mollusca (Br. A.), 390; Bridlington "Crag" Beds (Br. A.), 412
Jellett (Rev. Prof. J. H., M.R.I.A.), Opening Address, Sec. A, Br. A., 319
Jevons (W. Stanley), Lakes with Two Outfalls, 26
Johnson (Rev. S. J.), "Eclipses, Past and Future," 243
Johnston (Keith, F.R.G.S.), "Surface Zones of the Globe," 2
Journal of Botany, 216
Jute Fibre (Br. A.), 389

Kangaroos, proposed Acclimatisation of, 214
Kensington Catholic College, 382
Kent (W. Saville, F.L.S.), Manchester Aquarium, 93, 172
Kent's Cavern, Devonshire, Exploration of, 530
Kerguelen's Land, Expedition to, 33
Kiddle (Capt. W. M.), Brilliant Meteor, 44; Fogs and Icebergs in the Atlantic, 285
Kinetic Energy (Br. A.), 450
King's College, 134, 194, 213, 230, 331, 465, 511
Kirchhoff's Rules for Electric Circuits (Br. A.), 411
Kobell (F. de), "Les Minéraux," 500

Labiatæ, Fertilisation of, 92
Ladd (W.), Construction of large Nicol's Prisms (Br. A.), 451
Lakes with Two Outfalls, 5, 26, 44, 124, 185, 408
Land-Crabs, Can they Live under Water? 439, 482
Lankester (E. Ray), Specimens and Apparatus at Br. A., 263, 380; The Eye of Cephalopoda (Br. A.), 413; External Shell of Mollusca (Br. A.), 452; English Nomenclature in Biology (Br. A.), 453
Lardner's "Natural Philosophy," by B. Loewy, F.R.A.S., 102
Latchmore (J. jun.), Lunar Rainbow, 483
Latent Heat of Liquefied Gases (Br. A.), 389
Lawson (Prof.), Indian Ampelideæ (Br. A.), 433
Leaves temporarily Faded when exposed to the Sun, 149
Lebour (M.), Thermal Conductivities of Rocks (Br. A.), 386
Leeds: College of Science, 14, 55, 213, 230, 252, 447, 481, 528; Mechanics' Institute, 134; Naturalists' Field Club, 451, 514; Philosophical Society, 530
Le Gentil's Observations of the Transit of Venus (1761), 148
Leicester Literary and Philosophical Society, 274, 344
Leighton Buzzard Industrial Exhibition, 530
Lenz's Doctrine of Ocean Circulation, 170
Leverrier (M.), Meteorology in France, 515
Lewes (Geo. Henry), "Problems of Life and Mind," 1
Ley (W. Clement), U.S. Weather Maps, 460
Lick (James), his Gifts to California; Great Telescope, 271
Liege, Mining School, 448
"Life, The Origination of," by C. Darwin, F.R.S., 335
"Life and Mind, Problems of," by G. H. Lewes, 1

Light, Experiments on (Br. A.), 389 ; Polarisation of, 125
Lightning Conductors, 472
Lille, Meeting of Association for Advancement of Science, 286, 344, 357
Lindsay (Lord), his Photographic Arrangements for the Transit of Venus, 30 ; Photographic Irradiation, 85
Lindsay (W. Lauder), Mental Potentiality of Children of different Races, 272
Linnean Society, 57, 72, 137, 176, 216, 272
Liquids, Specific Volumes of (Br. A.), 452
Livingstone (The late Dr.), Government provision for his Family, 132
Liverpool, Naturalists' Field Club, 95, 296
Lobster Breeding in America, 214
Lockyer (J. N., F.R.S.), Atoms and Molecules Spectroscopically considered, 69, 89 ; Spectrum Photography, 109, 254 ; Spectroscopic Notes, Evidence of Variation in Molecular Structure, 154 ; Coggia's Comet, *With Sketch*, 149, 212, 226 ; Borrelly's Comet, 179
Loewy (B., F.R.A.S.), Lardner's "Natural Philosophy," 102
Logarithms, Tables of, 471
London University, 33, 195, 215 ; Female Education, 173, 395 ; Physics, 506, 525
Longevity of the Carp, 147, 165
Loomis (Prof.), U.S. Weather Maps, 295
Lovett (W. Jesse), Improved Filter Pump (Br. A.), 390
Lubbock (Sir John, Bart., F.R.S.), Appointment of a Minister of Education, 132 ; Stone Implements from Egypt, 138 ; Wild Flowers in relation to Insects (Br. A.), 402, 422
Lukis (W. C.), Rude Stone Monuments or Chambered Barrows, 290
Luminous Meteors (Br. A.), 430
Lunar Rainbows, 274, 482
Lyell (Sir C., Bart., F.R.S.), Freedom of Turners' Company conferred on, 172

Macalister (Prof.), Tongue of the Ant-eater (Br. A.), 413
Macleay (W., F.L.S.), his Gift to the Sydney University, 133
Macmillan (Rev. Hugh, LL.D.), "First Forms of Vegetation," 304
Magnetism, Terrestrial, 223
Maidstone Museum, 34
Mallet (Robt., F.R.S.), Expansion of Substances passing from Fusion to Solidification, 156
Man, Degeneracy of, 146, 163, 204
Manchester : Aquarium, 74, 93, 172, 174, 275, 428 ; Literary and Philosophical Society, 534 ; Geological Society, 35, 153 : Owens College, 53, 306, 351 ; "Essays and Addresses" at, 182 ; Prof. Huxley's Address on opening the Medical School, 455 ; Conversazione, 489
Mansell (J. P.), Natural History Notes from South Africa, 486
Mansel-Pleydell (J. C.), "Flora of Dorsetshire," 459
"Manufactured Articles," C. J. Monro on, 481
Marcet (Dr. W., F.R.S.), "Nutrition of Animal Tissues," 307
Marey (E. J.), Action of the Horse, 39 ; Movement of the Legs in Walking, 306 ; "Animal Mechanism," 498, 516
Maritime Meteorology, Conference on, 152, 195, 356, 381, 428
Marsh (Prof.), Brains of Tertiary Mammals, 273
Marshall (Prof. John, F.R.S.), Can Land-Crabs Live under Water ? 482
Mascarene Islands, Extinct Fauna of the, 72
Massachusetts, Proposed Survey of, 134
Mathematical Society, 23, 97, 132, 137, 488
Mathematical Tables, Report on (Br. A.), 372
Mathematical and Physical Science (*See* British Association, Sec. A)
Maunder's "Treasury of Natural History," by E. Holdsworth, F.L.S., F.Z.S., 283
Mauritius : Cyclone, 15 ; Meteorology, 418
Maxwell (Lieut. Wm., R.N.), Newfoundland Seal Fishery, 264
Measure, Standards of, 360
Mechanics, Bibliography of, 508
"Mechanics, Principles of," by T. M. Goodeve, M.A., 204
Mechanical Science (*See* British Association, Sec. G)
Medical Association, Meeting at Norwich, 293, 307
Medical School, Owens College ; Prof. Huxley's Address, 455
Medical School for Women, 446
Medical Studies, Hints on, 435
Medicine, Bibliography of, 509
Meldola (R., F.C.S.), Recent Researches in Photography, 281
Meldrum (C.), Meteorology in Mauritius, 418 ; Periodicity of Cyclones, Rainfall and Sunspots (Br. A.), 431
"Mental Physiology," by Dr. Carpenter, F.R.S., 40
Mental Potentiality of Children of different Races, 272
Mental Science, Journal of, 96, 373
"Metallurgy, Manual of," by W. H. Greenwood, F.C.S., 418
Metal Vaporised by Electricity, 190, 223
Meteors : Holyhead, 44 ; St. Andrew's, 305 ; Birmingham, 336 ; Rainhill, Wisbech, 482, 483 ; Burley, Hants, 419
Meteorological Committee of Royal Society, Report for 1873, 457
Meteorological Congress, Vienna, 17, 55
Meteorological Society, 98, 157
Meteorological Reform ; Prof. Balfour Stewart, F.R.S., and Lt.-Col. Strange, F.R.S. on, 476, 490
Meteorology : Argentine Republic, 72 ; Proposed Daily Weather Charts, 146 ; French National Observatory, 150, 215, 306, 515 ; Maritime, Conference on, 152, 381, 356, 428 ; Mauritius, 418 ; Necessity for placing it on a Rational Basis, by Lieut.-Col. A. Strange, F.R.S. (Br. A.), 490 ; Periodicity of Rainfall, 263 ; Present and Future, 99 ; Russia, 54 ; U.S. Weather Maps, 295, 460 (*See* Thunderstorm, Waterspout)
Metric Commission, International, 130
Meyer (Dr. A. B.), Herpetology of New Guinea, 191
Microscope : "Le Monde Microscopique des Eaux," by J. Girard, 500
Microscopical Science, Quarterly Journal of, 115
Microscopical Society, 38, 118, 514
Microscopy, Quarterly Journal of, 256, 513
Microzoa in Chalk Flints (Br. A.), 412
Migration of Birds, 415, 459, 520
Milk-cattle to Bees, 31
Milne-Edwards (M.), Extinct Fauna of the Mascarene Islands, 72
Miller (Samuel H.), The Edible Frog, 483
"Mind and Life, Problems of," by G. H. Lewes, 1
"Mineralogy," by F. Rutley, F.G.S., 161
Mineralogy : "Les Minéraux," by F. de Kobell, 500 ; Bibliography of, 510
Miners' Association of Cornwall and Devon, 274
Mining Academy, Friburg, 489
Mist Bows, 438
Mitchell (Prof. O. M'Knight), his Astronomical Work at Cincinnati Observatory, *With Illustrations*, 187
Moffatt (T. M.D.), Sun-spot and Atmospheric Ozone (Br. A.), 411
Moggridge (J. T.), Fertilisation of Fumariaceæ, 5 ; *Chrysomela Banksii*, 355, 419
Molecular Motion, 123
Molecular Structure, Evidence of Variation in, by J. N. Lockyer, F.R.S., 154
Mollusca, British (Br. A.), 390
Monk Fish, 428
Monro (C. J.), "Manufactured Articles," 481
Moore (D.), Tree-ferns (Br. A.), 433
Morrison (G. J.), Charts on Gnomonic Projection (Br. A.), 411
Mortality and the Seasons of the Year, 210
Moseley (H. N.), Botany of the *Challenger* Expedition, 165
Mosses of the North of Ireland (Br. A.), 433
Mott (F. T.), Cry of the Frog, 461 ; Colour of Flowers not due to Insects, 503, 520
Moupin (China), Mammals of, 32
Mueller (Baron F. von), Timber Trees and Plants for Culture in Victoria, 380
Muller (Fritz), Habits of Brazilian Insects, 102
Muller (Dr. Hermann), Fertilisation of Fumariaceæ, 5 ; Larvæ of Membracis as Milk-cattle to Bees, 31 ; Fertilisation of Flowers by Insects, 129
Müller (Prof. Max), International Congress of Orientalists, 420
Murchison (the late Sir Roderick I.), Memoir of, 232
"Murri" Race ; Australian Aborigines, 521
Museums and Exhibitions, 74, 529
Music in the Education of Women, 437
"Music and Sound," by Sedley Taylor, M.A., 496

Naples, Zoological Station, 73
National Museums, Meeting of the Society of Arts, 74
"Natural Philosophy," by Dr. Lardner (new edition by B. Loewy, F.R.A.S.), 102

Natural Selection and Dysteleology, 164
Newbiggin (J.), Chronology of Gas Lighting, 253
Newcastle-on-Tyne; College of Physical Science, 151, 351, 382
Newfoundland Seal Fishery, 264
New Guinea, Herpetology of, 191; Expedition of H.M.S. *Basilisk*, 294
Newton (Prof. Alfred, F.R.S.), Migration of Birds, 415
New York: Destruction of Mr. Waterhouse Hawkins's Models, 112; Museum of Natural History, 150; Fisheries, 214
New Zealand: Geology and Ornithology, 172; Salmon Culture, 215; Austrian Knighthood conferred on Dr. von Haast, Director of the Museum at Canterbury, 343; Observatory, 294; Flax, 448
Nicholson (Prof. H. A.), Polyzoa from Silurian Rocks (Br. A.), 412
Nicol's Prisms, Construction of (Br. A.), 451
Nitric Acid, Dissociation of (Br. A.), 452
Nomenclature, English, in Biology (Br. A.), 453
Nomenclature of Diseases, 436
Norfolk and Norwich Naturalists' Society, 174
Norgate (Fred.), The Telegraph in Storm Warnings, 125
Northampton: Sewage and Sewage Farming, 381
Nottingham: Education in, 94
"Nutrition of Animal Tissues," by Dr. W. Marcet, F.R.S., 307

Observatories: Cape of Good Hope, 295; Cordoba, 72; Minnesota, 134; Radcliffe (Oxford), 231; Paris, 15, 150, 213, 294 306, 307, 344, 358, 470, 515, 528; New Zealand, 294; Washington, 306, 307; Potsdam, 406; Puy-de-Dôme, 343; St. Petersburg, 54; San Francisco, 171; Vienna, Strasburg, 73, 470; United States, 186, 206
Ocean Currents, 52, 62, 83, 170, 484
Ogilvie (Mr.), Phosphoric Acid (Br. A.), 389
Olefines, Chlor-Bromides and Brom-Iodides of (Br. A.), 432
Oliver (Prof. F.R.S.), "Natural Orders of the Vegetable Kingdom," 222
Opium Derivatives (Br. A.), 432
Optical Delusion, 147
Optics of the Spectroscope, 467
"Organic Chemistry," by H. E. Armstrong, Ph.D., F.C.S., 333
Organ-pipes; Physical Action at the Mouth of, 161; Process of Tone-making, 481
Orientalists, International Congress of, 375, 419
"Ornithology, Field," by Dr. Elliot Coues, 146
Ornithology (*See* British Association, Sec. D)
Orwell, River, Discovery of a Buried Forest, 528
Osiers, Cultivation of, 448
Osteological Monograph-writing, 159
Ostrich-breeding, 253
"Out of Doors, or Practical Natural History," by the Rev. J. G. Wood, M.A., 519
Owen (Prof., F.R.S.), Ethnology of Egypt, 138; Oriental Ethnology, 420
Owens College, Manchester, 53, 306, 351, 407, 428: "Essays and Addresses," 182; Prof. Huxley's Address on opening the Medical School, 455; Conversazione, 489
Oxford, Science at, 73, 93, 113, 171, 172, 214, 230, 252, 511
Oyster-Trade, American, 290
Oysters, Scarcity of, 172
Ozone, Effects of (Br. A.), 413

"Painting, The Science of," by Prof. von Bezold, 221
Palaeotherium magnum, 124
Palestine Exploration Fund: Survey of Palestine, 151, 361; Meeting at the Duke of Westminster's, 253
Palgrave (W. G.), Atmospheric Currents in the West Indies, 65
Paper, New Material for, 427
Paris: Academy of Sciences, 20, 38, 58, 73, 78, 98, 118, 134, 138, 150, 158, 171, 178, 198, 218, 238, 258, 278, 298, 307, 330, 374, 394, 414, 427, 434, 454, 472, 494, 514; Acclimatisation Society, 76, 135, 196, 473, 514; Anthropological Society, 235, 297, 513, 533; Exhibition of Useful and Noxious Insects, 295, 407, 530; Geological Society, 16, 213; French Geological Works, 100; International Geographical Congress, 267; International Metric Commission, 130; Observatory, 15, 150, 213, 294, 306, 307, 344, 358, 470, 515, 528; Reptile-House in the Jardin des Plantes, 472, 510
Parker (Prof.), Hunterian Lectures on the Vertebrate Skull, 9, 107, 167, 249, 444
Parrots, Classification of, 466
Pasteur (M.), Pension granted to, 252
Patent Museum, its proposed removal, 232
Pavy (F. W., M.D.), "Food and Dietetics," 60
Payer (Lieut.), Austrian Arctic Expedition, 439, 523
Peabody Museum, Harvard (U.S.), 344
Peat Manufacture in Germany, 294
Penikese Zoological School, 94
Pennsylvania, Geological Survey of, 231
Periodicity of Rainfall, 263
Peroxide, Reaction of (Br. A.), 432
Peruvian Skull, 46, 123, 355
Peschel (Dr. Oscar), Degeneracy of Man, 204
Pfluger on the Salivary Glands of the Cockroach, 381
Pharmaceutical Conference, 489
Philadelphia: Academy of Natural Sciences, 16, 77, 217, 276, 297, 474, 514; Franklin Institute, 274, 276, 373
Phipson (Dr. T. L.), Cyanogen in Commercial Bromine, Sesquisulphide of Iron (Br. A.), 432
Phosphoric Acid (Br. A.), 389
Photographic Irradiation, 63, 85, 185, 205, 222, 245, 381, 439, (Br. A.), 449, 522
Photographic Society, 407, 467
Photography: "Amateur's Guide Book," by W. J. Stillman, 284; Recent Researches, 281
Photography (Spectrum), by J. N. Lockyer, F.R.S., 109, 254
Photography (Spectrum), and Photo-chemistry, 243
Photography in Transit of Venus (Br. A.), 449
Phylloxera vastatrix and the Vine Disease, 172, 252, 471, 472, 503, 530
Physical Axioms, 3, 25, 43, 84, 103, 123, 305, 335
"Physical Forces, Correlation of," by the Hon. Sir W. R. Grove, F.R.S., 302
"Physical Manipulation," by Prof. Edw. C. Pickering, 160
Physical Science (*See* British Association, Sec A)
Physics, Teaching in Schools (Br. A.), 410; at the London University, 525; Bibliography of, 508
"Physiology," by M. Foster, M.D., F.R.S., 261
"Physiology for Practical Use," by Jas. Hinton, 121
Physiology (*See* British Association, Sec. D)
Pickering (Prof. Edw. C.), "Physical Manipulation," 160
Pigeons used for Press purposes, 360
Pitcher-Plants, 253, 463, 512 (*See* Carnivorous Plants)
Plants, Carnivorous, by Dr. Hooker, C.B., Pres. R.S. (Br. A.), 366
Plants, De Candolle's proposed "Physical Groups" of, 121
Plateau (Prof. J.), Soap-bubbles, 119
Poggendorff's *Annalen der Physik und Chemie*, 18, 36, 75, 154, 453
Poisonous Snakes of Australia, 273
Polar Exploration (*See* Arctic Exploration)
Polarisation of the Aurora, 398
Polarisation of Light, by W. Spottiswoode, Treas. F.R.S., 125
Pollen-grains in the Air, 355, 398
Pollen-grains, Form of (Br. A.), 433
Polyzoa from Silurian Rocks (Br. A.), 412
Ponti (Girolamo), his bequest to "Academies of Science," 427, 470
Potato Disease (Br. A.), 390
Potsdam Observatory, 406
Power (H.), *Chrysomela Banksii*, 419
Prestwich (Prof. Joseph, F.R.S.), Deep-Sea Temperatures; Lenz's Doctrine, 170; Geology of Portland and Weymouth, 176; Geology of Proposed Channel Tunnel, 181
Priestley (Dr. Joseph), his Statue at Birmingham, 213; Proposed Centenary Commemoration, 230, 252; Memoir of, 239
Primroses destroyed by Birds, 6, 24
Procter (Henry R.), Aurora Borealis, 355
"Protoplasmic Theory of Life," by J. Drysdale, M.D., 519
Pryer (R. A.), Antipathy of Spiders to Chestnut Wood, 26
Public Schools Commission; Proposed Regulations, 219
Purser (J., M.R.I.A.), Kinetic Energy (Br. A.), 450
"Pyrogen," a new Gas, 512

Rabbits: their Care for their Dead, 264; Is the Rabbit Indigenous? 461
Rain, Influence of Forests on, Report on (Br. A.), 373
Rainbows, 274, 398, 437, 460, 483, 503, 522; Mist Bows, 438
Rainfall of 1873-74, Report on (Br. A.), 342

Rainfall, Periodicity of, 263 (Br. A.), 431
"Rainfall of Barbados," by Governor Rawson, C.B., 241
Ranyard (A. Cowper, F.R.A.S.), Coggia's Comet, 184; Photographic Irradiation, 85, 205, 223, 245, 522
Rawson (Governor, C.B.), "Rainfall of Barbados," 241; Periodicity of Rainfall, 263
Ray Society, 343
Rayleigh (Lord, F.R.S.), Gift to the Mathematical Society, 132
Redfern (Prof. Peter, M.D.), Opening Address, Sec. D, Br. A., 327; Effects of Ozone (Br. A.), 413
Rennie (Sir John, F.R.S.), Obituary Notice of, 383
Reptile House in the Jardin des Plantes, 510
Research, Endowment of (*See* Endowment of Research)
Research, Private Aid to, 244, 286
Reynolds (Prof. Emerson), Sulphur-Uréa (Br. A.), 390
Reynolds (Prof. Osborne), Evaporation and Condensation, 174
Reynolds (R.), Yorkshire College of Science, 481
Ribot (Th.), "English Psychology," 82
Ridley (Wm.), Aboriginal "Murri" Race of Australia, 521
Riley (Prof. C. V.), Pitcher-Plant Insects, 463
Rodier (A.), Vaporising Metals by Electricity, 223
Rodrigues: Expedition to, 33; its Extinct Fauna, 72; Geology and Botany, 527
Root (Chas. G.), The Germans and Physical Axioms, 123
Roman War Implements from Trojan's Column, 273
Roman Well, Ashill, Norfolk, 529
Romanes (Geo. J.), Disuse as a Reducing Cause in Species, 164; Care of Rabbits for their Dead, 264; Migration of Birds, 520; Rainbows, 483
Roscoe (Prof. H. E., F.R.S.), Absorption-spectra of Potassium and Sodium, 136; Abnormal Chlorides (Br. A.), 452
Royal Commission on Scientific Instruction, 21, 331, 351
Royal Society, 19, 36, 56, 96, 136, 154, 174, 197, 258; Report of Meteorological Committee, 457
Ruchonnet (Charles), Curves and Numbers, 262
Rugby School Natural History Society, 2
Russia: Meteorology, 54; Exploring Expeditions, 171
Russell (Hon. F. A. R.), Governor Rawson's Report on the "Rainfall of Barbados," 241
Russell (Lord Arthur), The Edible Frog, 520
Rutley (F., F.G.S.), "Mineralogy," 161

St. Andrew's University, 427
St. Petersburg, Horticultural Garden, 448
Salem (U.S.), Essex Institute, 153
Salivary Glands of Cockroach, 439
Salvin (Osbert, F.R.S.), Strickland Curator at Cambridge, 250
Samoa, Reported Discovery of Gold, 522
Samuelson (B., M.P.), Technical Instruction, 492
Sanderson (Dr. J. Burdon, F.R.S.), Venus's Fly-trap, 105, 127; Localisation of Functions in the Brain, 245
San Francisco Marine Aquarium, 94
"Sanitary Arrangements for Dwellings," by W. Eassie, C.E., 161
Sardines, Cornish, 407
Scammon (Capt. C. M.), Marine Mammals of the North Pacific, 274
Schliemann (Dr.), Discoveries in the Ruins of Troy, 384
School of Mines, Award of Prizes, 196
Schuster (Arthur), Prot. Bezold's "Science of Painting," 221; Curious Rainbow, 437
Scientific Instruction, Royal Commission on, 21, 331, 351
SCIENTIFIC WORTHIES:—III. Charles Robert Darwin, *With Portrait*, 79; IV. John Tyndall, *With Portrait*, 299
Sclater (P. L., F.R.S.), Royal Society's Soirée, 3; Lectures at Zoological Gardens, 7; Distribution of Cassowaries (Br. A.), 390
Scott (R. H., F.R.S.), Proposed Daily Weather Charts, 146; Austrian Order conferred on, 150; Conference for Maritime Meteorology, 152, 356, 428; Colliery Explosions and the Weather, 157; Planimeter for Meteorological Instruments, 197; Waterspout at Milford Haven, 263
Seal Fisheries, 85, 173, 264, 470
Seaweed in Aquariums, 530
Secchi (Father), his work on the Sun, 3; Sun-spots, 534
Sedgwick (Dr. Leonard W.), Spontaneous Generation Experiments, 4
Sedgwick (The late Prof.), Memorial to, 54; Bust of him given to the Geological Museum, 194
Selection, Laws of; their Application to Agriculture, 350
Selenka (Prof.), his Aquaria at Leyden and Erlangen, 260
Selwyn (Alfred R.), Geological Survey of Canada, 144
Sensitive Flames, 244, 273, 286
Settle: Exploration of the Victoria Cave (Br. A.), 387; "Flora of," by John Windsor, 459
Sewage, Utilisation of (Br. A.), 431
Sewage and Sewage Farming, 381
Shark, Skate-toothed, in Manchester Aquarium, 275
Sharks, Development of (Br. A.), 413
Sharpe (R. Bowdler) "Birds in the British Museum," 378
Sherrard (William), Biographical Notice of, 73
Sicily: Sulphur Mines, 271; Tea Cultivation, 360
Siderostat, The, 358
Siemens (Messrs.), Telegraphic Cable Works, 15
Siemens (C. W., D.C.L., F.R.S.), The *Faraday* and her Appliances for Cable-laying, 64
Siemens' Pyrometer, Report on (Br. A.), 372
Silvestri (Prof. Orazio), Eruption of Mount Etna, 522
Simpson (Prof. Maxwell, F.R.S.), Chlor-bromides and Brom-iodides of the Olefines (Br. A.), 432
Skull, Peruvian, 123, 355
Skull, Vertebrate (*See* Hunterian Lectures)
Smith (Geo.), his Assyrian Expedition, 134
Smith (Hermann), Physical Action at the Mouth of Organ-pipes, 161; Tone-making in Organ-pipes, 481
Smyth (R. Brough), Geological Survey of Victoria, 200
Snakes of Australia, 273
Sneezing in Animals, 522
Soap-bubbles, Prof. J. Plateau on, 119
Social Science Congress, Meeting at Glasgow, 462, 492
Society of Arts, 34, 54, 94, 151, 307
Sorby (H. C., F.R.S.), Temporary Fading of Leaves exposed to the Sun, 149
"Sound and Music," by Sedley Taylor, M.A., 496
Sounding and Sensitive Flames, 244, 273, 286
South Kensington: Natural History Museum, 132; Proposed removal of Patent Museum, 232
Southwell (Thos., F.Z.S.), Seal Fishery, 85
Spalding (Douglas A.), "Problems of Life and Mind," by G. H. Lewes, 1; Ribot's "English Psychology," 82; Automatism of Animals, 520
Spar Caves of the North Bridge, Edinburgh, 8
Spectroscope: De Boisbaudran on "Spectres Lumineux," 396; Optics of the, 467
Spectroscopic Observations of the Comet of July 1874, 179
Spectrum Analysis, Researches in, by J. Norman Lockyer, F.R.S., 258
Spectrum Photography, by J. N. Lockyer, F.R.S., 109, 254
Spectrum Photography, Early Contributions to, 243
Spectrum of Aurora Borealis, 210
Spencer (Herbert), Necessary Truths and *à priori* Physical Axioms, 3, 25, 43, 84, 103, 123, 305, 335
Spiders, their Antipathy to Spanish Chestnut Wood, 6, 26
Spider, Fossil, 308
Spitzbergen, Coal at, 472
Spontaneous Generation Experiments, 4; (Br. A.), 389
Spottiswoode (W., Treas. F.R.S.), Polarisation of Light, 125
Squirrels, Habits of, 503
Standards, Metric, 130
Stanley (H. M.), Expedition to investigate the African Slave Trade, 195
State Aid to Science, 22, 132, 286
Statistical Society, 195, 472
Statistics (*See* British Association, Sec. F)
Stewart (Prof. Balfour, LL.D.), Experiments on a Magnetised Copper Wire, 96
Stewart (S. A.), Mosses of the North of Ireland (Br. A), 433
Stillman (W. J.), Photographic Irradiation, 63, 85, 205, 381; "Amateur's Photographic Guide Book," 284
Stockholm, International Congress of Anthropology and Archæology, 307, 332
Stokes (Prof. G. G.), Construction of a perfectly Achromatic Telescope (Br. A.), 431
Stoliczka (Ferdinand, Ph.D.), Obituary Notice of, 185; Memorial to, 528
Stone (Mr., Astronomer Royal of the Cape), Observations of the African Eclipse, 59
Stone Implements: in Egypt, 138; Tasmania, 173; Feathering in Flint Weapons, 245; Kent's Cavern, 532
Stone Monuments or Chambered Barrows, 290

Strange (Lieut.-Col. Alex., F.R.S.), Public Physical Laboratory, 21 ; Education of Women, 437 ; Meteorological Reform (Br. A.), 476, 490
Strasburg Observatory, 73, 470
Strickland Curatorship, Cambridge, 250
Sub-Wealden Exploration, 15, 114, 151, 220, 469; Report on (Br. A.), 373
Suffield (Rev. R. R.), Longevity of the Carp, 147
Sugar, its cultivation in Spain and Jamaica, 360
Sulphur: from Sicily and Iceland, 271 ; Near Auckland, 294
Sulphur-Urea (Br. A.), 390
Sun, The: Father Secchi's Work, 3 ; Researches in Spectrum Analysis, by J. N. Lockyer, F.R.S., 258
Sun-spots, Father Secchi on, 534
Sun-spots and Atmospheric Ozone (Br. A.), 411
Sun-spots, Periodicity of (Br. A.), 431
"Surface Zones of the Globe," by Keith Johnston, F.R.G.S., 2
Swettenham (R. P. A.), Curious Rainbow, 398, 437, 522
Sydney, Science in, 55, 133, 252, 344
Symons' "British Rainfall," 114

Tait (Prof. P. G., F.R.S.E.), Bright Meteors, 305 ; Rainbows, 437, 460, 483
Tait (Dr. Lawson), Feathering in Flint Weapons, 245
Tanner (H. W. Lloyd), Aid to Private Research, 244, 286
Tasmania, Royal Society, 173
Taylor (Sedley, M.A.), "Sound and Music," 496
Tea, its growth in Sicily, 360
Technical Education, 492, 512, 529
Tegetthof, Austrian Polar Expedition, 273, 383, 428, 439, 523
Tegetmeier (W. B., F.Z.S.), Boddaert's Catalogue of Birds, 123 ; Migration of Birds, 520
Telegraph in Storm-warnings, 125
Telegraphic Cable Works, 15
Telegraphic Engineers' Society's Journal, 116
Telescopes, Achromatic, Construction of (Br. A.), 431
Telescope, Great, for California, 271
Temperature of the Deep Sea, (*See* Deep-sea Temperature)
Terrestrial Magnetism, 223
Testimonials to Scientific Candidates, 241
Thelwall (W. B.), Lakes with Two Outfalls, 44
Thermal Conductivities of Rocks, Report on (Br. A.), 386
Thomson (G. J.), Curious Rainbow, 522
Thomson (Sir Wm.), Endowment of Research, 22 ; Perturbations of the Compass by Ship's Rolling (Br. A.), 388
Thompson (Prof. Jas., LL.D.), Opening Address, Sec. G, Br. A., 390
Thorpe (Prof.), Specific Volumes of Liquids (Br. A.), 452
Thunderstorm, Remarkable, 380
Tiddeman (R. H.), Exploration of Victoria Cave, Settle (Br. A.), 387
Timber Trees and Plants for Culture in Victoria, 380
Timbs (John), "Year Book of Facts," 122
Tone-making in Organ-pipes, 481
Torbitt (J.), Potato Disease (Br. A.), 390
Torquay Natural History Society, 115
Transits of Venus [1639], 190 ; [1761] Le Gentil's Observations, 148 ; [1874], 11, 27, 33, 49, 66, 73, 86, 114, 151, 158, 172, 190, 426, 449
Trap, Fossils in, 398, 419
Tree-ferns (Br. A.), 433
Trees "pierced" by other Trees, 6, 26
Troy, Ruins of ; Recent Discoveries of Dr. Schliemann, 384
Tunnel between England and France, 181, 357
Turners' Company ; Freedom conferred upon Sir C. Lyell, Bart., F.R.S., 172
Tuscany, Pharmacy in, 489
Tylor (Edward B., F.R.S.), Degeneracy of Man, 146, 204, 205
Tyndall (Prof. John, D.C.L., F.R.S.), Memoir of, *With Portrait*, 299 ; Inaugural Address at British Association, 309
Tyrone Coal-field (Br. A.), 432

Uncompensated Chronometers, 63, 85
University College, 171, 331, 356, 382 ; Physics at, 506, 525
Universities Commission ; Report, 475, 495

Van der Waals (J. D.), "Continuity of the Gaseous and Liquid States," 477
Vaporising Metals by Electricity, 223
"Vegetable Kingdom, Natural Orders of the," by Prof. Oliver, F.R.S., 222
"Vegetation, First Forms of," by the Rev. Hugh Macmillan, LL.D., 304
Venus, Transits of [1639], 190 ; [1761], Le Gentil's Observations, 148 ; [1874], 11, 27, 33, 49, 66, 73, 86, 114, 151, 158, 172, 190, 426, 449
Venus's Fly-trap, Dr. Burdon Sanderson, F.R.S., on, 105, 127
Vertebrate Skull, Prof. Parker on the, 9, 107, 167, 249, 444
Vibrations of Air produced by Heat, 233
Victoria: Forest Trees, 35 ; Geological Survey, 200 ; Timber Trees and Select Plants for Culture, 380
Vienna: Meteorological Congress, 17, 55, 428 ; Imperial Academy of Sciences, 78, 258, 278, 298 ; Observatory, 470
Villars (Gauthier), Annals of the Observatory, Paris, 15
Vine Disease, 94, 172, 252 ; its progress in the South-east of France, *With Map*, 503
Vivisection, 33
Vogel (Dr. Herman), Researches in Photography, 281
Volcano, Submarine, Society Islands, 384
Volcanoes (*See* Etna)
Volcanic Phenomena of County Antrim (Br. A.), 324

Wakefield (C.), Remarkable Thunderstorm, 380
Walker (John C.), Waterspout at Milford Haven, 263
Walking ; Movement of the Legs, 306
Wallace (Alfred R.), Migration of Birds, 459 ; Automatism of Animals, 502
Waller (Thos. H.), Meteors, 336
Warren (Capt.), Palestine Exploration, 151, 253, 361
Washington: National Academy of Science, 45 ; Naval Observatory, 188
Waterspout at Milford Haven, 263
Watson (Dr. Forbes), Proposed Indian Institute, 421
Wave Numbers, Tables of, Report on (Br. A.), 373
Weather Charts, Daily, proposed, 146, 460
Westminster Hospital, Laboratories, 307
Wetterhan (J. D.), Automatism of Animals, 438
Weyprecht (Lieut.), Austrian Arctic Expedition, 523
Whale taken at New Zealand, 16
Whalley (W.), "The Human Eye," 243
White (Gilbert), Memorial to, 152
Whitworth Scholarships, 254
Wild Flowers and Insects (*See* Insects)
Williams (Dr.), Alga from Jersey (Br. A.), 433
Wilson (Prof. Daniel), The Long Peruvian Skull, 46, 355
Wilson (W. G., M.A.), "Elementary Dynamics," 204
Winchester Scientific Society, 296, 534
Windsor (John), "Flora of Settle in Craven," 459
Wood (Rev. J. G., M.A.), "Out of Doors ; or, Practical Natural History," 519
Woolwich Aeronautical Experiment, 461
Women, Education of (*See* Female Education)
Workman (Chas.), Salivary Glands of Cockroach, 439
Wright (Dr.), Opium Derivatives (Br. A.), 432
Wright (Jos.), Microzoa in Chalk Flints (Br. A.), 412
Wunsch (E. A.), Fossils in Trap, 419
Wurtz (M.), "Theory of Atoms in the General Conception of the Universe," 345
Wyman (Prof. Jeffries, M.D.), Long Peruvian Skull, 124 ; Obituary Notice of, 487 ; Sonnet on, 512

Yorkshire College of Science, 14, 55, 213, 230, 252, 447, 481, 528

Zizania aquatica, a new Material for Paper, 427
Zoological Formulation and Evolution, 465
Zoological Gardens: Lectures, 7 ; Effects of Gunpowder Explosion, 470 ; Additions to, 17, 35, 55, 74, 95, 115, 134 152, 174, 196, 213, 215, 230, 232, 254, 275, 295, 308, 344, 361, 384, 408, 428, 448, 472, 490, 513, 530
Zoological Society, 19, 37, 77, 117, 157, 195, 306
Zoology (*See* British Association, Sec. D)

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

THURSDAY, MAY 7, 1874

LEWES'S "PROBLEMS OF LIFE AND MIND"

Problems of Life and Mind. By George Henry Lewes. First Series: The Foundation of a Creed. Vol. I. (Trubner & Co.)

IN this volume Mr. Lewes speaks in an attractive, if rather conversational way, on a great many philosophical and psychological topics; but the most striking feature of the book is the many announcements of discoveries and original views to be proved and elaborated in future volumes. And the author's opinion that the work is of "somewhat ambitious pretensions" is, we think, likely to be shared by his readers.

We are promised a Psychology, but introductory thereto Mr. Lewes has produced two volumes (the second is now under final revision), in which he aspires to lay the Foundation of a Creed. "The great desire of this age is for a doctrine which may serve to condense our knowledge, guide our researches, and shape our lives, so that Conduct may really be the consequence of Belief." Perhaps there is a general, certainly not a universal, longing for something of this kind. The first question is, what is to be the fate of this hunger of the soul? Is this longing doomed to perish for want of an object? or is it destined to be satisfied? If so, how? Religion, thinks Mr. Lewes, is not to die, but to be transformed.

According to Mr. Lewes this new Religion, "Instead of proclaiming the nothingness of this life, the worthlessness of human love, and the imbecility of the human mind, will proclaim the supreme importance of this life, the supreme value of human love, and the grandeur of the human intellect." The first half of this fine sentence is entirely negative; it tells us that the new creed will not seek to suppress or degrade human nature, after the manner imputed to some of the old religions. This is well, and, as it seems to us, sufficient for all that Mr. Lewes, so far as we can make out, has in view.

Before this new doctrine, which is to reconcile the claims of Religion and Science, can be established, it is necessary as a preliminary to transform Metaphysics. Accordingly Mr. Lewes has applied himself to this task. Defining Metaphysics as the "Science of the most general conceptions," to be pursued solely by the method of Science, he discards "all inquiries whatever which transcend the ascertained or ascertainable data of experience." As a name for the province which he thus excludes from metaphysics, he suggests the word *metempirics;* and as *metempirical* has much to recommend it, besides its being the exact correlative of empirical, it will, we hope, establish itself as a useful addition to the language of philosophy. Mr. Lewes anticipates very large results from systematically keeping in view as a principle of research the necessity of clearly and completely eliminating from the statement of each problem all metempirical elements. In the light of this method all mystery, it seems, will vanish from the universe, as the shadows of the morning fly before the rising sun:—"When rationally stated there is no greater mystery in the existence of an external world, or the relations between object and subject, than the relation between activity and waste in the tissues." For, though as Mr. Lewes observes, "it may seem a very bold thing to say," yet he believes and hopes to show that "we not only know that an external Not-self exists,—know it with the same assurance that we know an internal Self to exist, but we also know the manner in which the two are combined in Feeling and Thought." Mr. Lewes will certainly have philosophised to some purpose if he put us in possession of a principle of research that will enable us so completely to transcend what at present appears to be the highest reach of our powers. One condition of understanding the manner of a combination has hitherto been a knowledge of the elements in separation. If we know how oxygen and hydrogen combine to form water, it is because we know these gases otherwise than combined in water. But of the Self and Not-self we know nothing, and can never know anything save as feeling and thought. In the author's own words, "all that we can know of the external is what we have felt or might feel." Nor do we see at this moment that this criticism would lose its point even were we to accept Mr. Lewes's peculiar doctrine of the subject and object. When explaining how men came to lose faith in the reality of the objective, he points out that by dwelling on the fact that the same subject produces various sensations at different times, they at last "reversed their primary and instinctive judgment, and instead of saying 'qualities belong to objects,' they now said, 'It is we who invest objects with the qualities of our feelings.'" This he seems to regard as giving an undue predominance to the "subjective aspect." We venture to think that it would be more in accordance with the established use of language to describe the error referred to as a failure to observe that the sensations varied, not only with changes in the object, but also with changes in the material organism called our body,—which never was the "*we*" of the philosophers who hold that it is *we* who invest objects with the qualities of our feelings. Looked at from this point of view, the whole truth within our reach is simply this, that with the same external object and the same bodily condition, the same state of consciousness will invariably arise. The peculiarity of Mr. Lewes's position, if we understand it, is that he means by the *Self* the living body, the "sentient organism" *as we know it*, and by the Not-self the external surrounding *as known to us*; for his *reasoned realism* forbids him to seek after any deeper reality of things,—the absolute is what we see and hear. So far are we, as it appears to us, from knowing how the action of external forces on the living organism results in *feeling*, that we cannot make the very least approach to a conception of such a thing. Recognising that each feeling is related to certain vibrations set up in the nervous structure by the action of external agents, which vibrations Mr. Lewes describes as expressed by the feeling, this, as far as we can see, brings us no nearer to a conception of any sense in which "the feeling *is* what it expresses"—is the vibrations. Mr. Lewes will have to say much more than he has yet said, before we shall be able to see with him that stimuli plus mechanism can ever yield an explanation of sensation.

We regret that our space will not permit us to notice any other of the many important topics touched on in this volume. The whole demands, and will fully repay, a careful reading from every student of these matters. Only the first of Mr. Lewes's problems—the Limitations of Knowledge—is worked out at full length, the chapter on Necessary Truths being perhaps the most interesting. In the last chapter Mr. Lewes considers the place of sentiment in philosophy. What he has to show is that Sentiment, or Emotion, is one important source of knowledge. But what he says is more likely to impress his readers with its power of obscuring vision and obstructing research.

DOUGLAS A. SPALDING

OUR BOOK SHELF

Report of the Rugby School Natural History Society for the year 1873. (Rugby: W. Billington, 1874.)

THIS Report is on the whole very satisfactory, and the tone of the preface exceedingly hopeful. At no time in its past history of seven years, the retiring president tells us, does the Society seem to him to have contained more promising workmen. It appears that it has been resolved to construct a geological model of the Rugby district, and for this *magnum opus* many volunteers from the Society have offered their assistance. The appended reports of the various sections are on the whole satisfactory, showing that real work is being done. One of the most valuable features in the Report for 1873 is the number of papers which have been read by the young members themselves, there being seven printed here in greater or less fulness, and a number of others mentioned as having been read at the regular meetings of the Society. One of the most interesting of the published papers is one by Mr. H. N. Hutchinson On Home-made Electrical Apparatus, showing that the author possesses very considerable originality and ingenuity. The apparatus described was made by his brother and himself five years ago, and includes some of the most essential parts of an electrical equipment, the cost of the whole not being more than a few shillings. He thus tells us how the cylinder of an electrical machine may be manufactured. "Choose a tall glass jar, such as you see in confectioners' shop-windows. Next get two wooden caps turned to fit on to the ends of the cylinder, about an inch deep, with projecting pivots. The caps are next to be cemented on to the ends of the cylinder. The cement is composed of resin, beeswax, red ochre, and a little plaster of Paris, and must be heated over a slow fire. The open end of the cylinder must be first covered over with a piece of silk to prevent bits falling in." The conductor was made of deal wood turned to the proper shape and covered very smoothly with tinfoil; the Leyden jars were made from ordinary plum jars. We recommend the paper with its accompanying sketches to those who cannot afford to buy an electrical apparatus. W. B. Lowe describes some carefully made experiments On Cohesion of Water at Various Temperatures; and other papers by pupils, evincing considerable power of observation, are—On an Excursion of Mr. Wilson's Geological Class to Mount Sorrel, by C. M. Kerr; On a Botanical Expedition to Princethorpe, by H. W. Trott; On a Geological Expedition to Atherstone and Nuneaton, by E. Mann; On an Entomological Expedition to Frankton Wood, by H. A. Bull; and On the Chameleon, by J. S. Beuttler, giving an account of the author's own observations on two specimens belonging to himself. Besides these there are several other papers by masters and outsiders; one of the latter is a very instructive paper by Mr. R. H. Scott, F.R.S., On the Weather. The Report also contains four plates by pupil members of the Society.

The Surface Zones of the Globe. A Handbook to accompany a Physical Chart. By Keith Johnston, F.R.G.S. With two Maps and six Illustrations. (W. and A. K. Johnston, 1874.)

THIS little volume will form an interesting and valuable addition to our educational manuals, either as a lesson-book for pupils or as a handbook for teachers. The author divides the surface of the globe into seven great zones, and shows that, without considering the particular species of plants, or the more minute details of the forms of natural life which occur in these belts, and which may differ in one continent from another, there is a resemblance in character throughout the whole extent of each zone, whether of forest, or pasture, or desert, which cannot be mistaken. Mr. Johnston names these zones as follows:—1. The Equatorial Forest Region; 2. The Equatorial Pasture Lands; 3. The Deserts; 4. The Temperate Pasture Lands; 5. The Temperate Forests; 6. The Barren Tundra Regions; 7. The Icy Polar Regions. He describes in detail the characteristic appearance and productions of each region, and in doing so manages to convey a considerable amount of useful information. The manual is intended to accompany a large chart of the world on which these surface zones are distinguished, and a minute copy of which forms one of the diagrams of the work. Another very curious and interesting diagram is intended to show the surface zones on the supposition of a change of 90° in the position of the earth. The coloured illustrations showing the characteristic appearances of the various zones are as successful as anything of the kind we have seen, although, what perhaps cannot be avoided in coloured illustrations of this kind, there is a little too much of "the light that never was on sea or land" upon them.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

Necessary Truths—Physical and other

I AM not about to continue a controversy which I regret having been provoked into by the misrepresentations of one who ignored the contents of works he professed to review. Reply and rejoinder may go on endlessly. I could not, to much purpose, argue with Mr. Hayward, who, instead of taking such unconsciously-formed preconceptions as those resulting from the infinite experiences of muscular tensions and their effects, proposes to exemplify unconsciously-formed preconceptions by a consciously-formed hypothesis concerning the relation between weight and motion. Nor should I care to discuss any question with my new anonymous assailant; who, when certain examples given show the "exact quantitative relations" spoken of to be those of direct proportion, describes me as "intensely unmathematical" because I subsequently use the more general expression as equivalent to the more special—which, in the case in question, it is.

The first of my objects in now writing is to remind "some bystanders, who may from their antecedents be presumed competent to judge," that the essential question is not a mathematical one, but a logical and psychological one, in respect of which I am not aware that senior wranglers, as such, can claim any special competence. Further, even admitting the assumption that the question is mathematical, I have to warn the reader that he will be much misled if he infers that there are not "some bystanders who may from their antecedents be presumed" *more* "competent to judge," who concur in the opinion that the laws of motion cannot be demonstrated experimentally.

My second object is to inclose, for publication in NATURE, a passage now standing in type to be added to future impressions of "First Principles" in further elucidation of necessary truths, and our apprehensions of them.

HERBERT SPENCER

"The consciousness of logical necessity, is the consciousness that a certain conclusion is implicitly contained in certain premisses explicitly stated. If, contrasting a young child and an adult, we see that this consciousness of logical necessity, absent from the one, is present in the other, we are taught that there is a *growing up* to the recognition of necessary truth, merely by the unfolding of the inherited intellectual forms and faculties.

"To state the case more specifically:—Before a necessary truth can be known as such, two conditions must be fulfilled. There must be a mental structure capable of grasping the terms of the proposition and the relation alleged between them; and there must be such definite and deliberate mental representation of these terms as makes possible a clear consciousness of this relation. Non-fulfilment of either condition may cause non-recognition of the necessity of the truth; and may even lead to acceptance of its contrary as true. Let us take cases.

"The savage who cannot count the fingers on one hand, can frame no definite thought answering to the statement that 7 and 5 make 12; still less can he frame the consciousness that no other total is possible.

"The boy adding up figures inattentively, says to himself that 7 and 5 make 11; and may repeatedly bring out a wrong result by repeatedly making this error.

"Neither the non-recognition of the truth that 7 and 5 make 12, which in the savage results from undeveloped mental structure, nor the assertion, due to the boy's careless mental action, that they make 11, leads us to doubt the necessity of the relation between these two separately-existing numbers, and the sum they make when existing together. Nor does failure from either cause to apprehend the necessity of this relation make us hesitate to say, that when its terms are distinctly represented in thought, its necessity will be seen; and that apart from any multiplied experiences, this necessity becomes cognisable when structures and functions are so far developed that groups of 7 and 5 and 12 can be intellectually grasped.

"Manifestly, then, there is a recognition of necessary truths, as such, which accompanies mental evolution. Along with acquirement of more complex faculty and more vivid imagination, there comes a power of perceiving to be necessary truths what were before not recognised as truths at all. And there are ascending gradations in these recognitions. Thus a boy who has intelligence enough to see that things which are equal to the same thing are equal to one another, may be unable to see that ratios which are severally equal to certain other ratios, that are unequal to each other, are themselves unequal; though to a more developed mind this last axiom is no less obviously necessary than the first.

"All this, which holds of logical and mathematical truths, holds, with change of terms, of physical truths. There are necessary truths in Physics, for the apprehension of which, also, a developed and disciplined intelligence is required; and before such intelligence arises, not only may there be failure to apprehend the necessity of them, but there may be vague beliefs in their contraries. Up to comparatively recent times, all mankind were in this state of incapacity with respect to physical axioms; and the mass of mankind are so still. Various popular notions betray inability to form clear ideas of forces and their relations, or carelessness in thinking, or both. Effects are expected without causes of fit kinds; or effects extremely disproportionate to causes are looked for; or causes are supposed to end without effects. But though many are thus incapable of grasping physical axioms, it no more follows that physical axioms are not knowable *à priori* by a developed intelligence, than it follows that there is no necessity in logical relations because many have intellects not developed enough to perceive the necessity.

"The ultimate physical truth of which clear apprehension is eventually reached, is that force can neither arise without an equivalent antecedent, nor disappear without an equivalent consequent. Along with power of introspection there comes recognition of the fact that existence cannot be conceived as beginning or ending: the Laws of Thought themselves negative any such mental representation. And if it be asked why this intuition, which all physical axioms indirectly imply, and which is postulate in every physical experiment, is to be taken as authoritative because its negation is inconceivable, the answer is that no argument which sets out to discredit it can do this without logical suicide; since there is no other warrant for asserting the dependence of any conclusion on its premisses than the inconceivability of its negation."

This passage forms part of a revised version of the chapters on Matter, Motion, and Force, which I have contemplated making for this year past. When those chapters were written and stereotyped in April 1861 (see Preface), the modern doctrines concerning Force and its transformation were so imperfectly developed, that some of the leading technical words now currently used were not introduced. The reorganisation of "First Principles," which I made in 1867, for the purpose of more truly presenting the general Theory of Evolution, did not implicate these chapters, and I believe I did not even re-read them: the stereotype plates, in common with those of many other chapters, with the numberings of pages and sections altered, were used afresh, and continue still to stand as they originally did. But while now rectifying defects of statement which it was scarcely possible to avoid thirteen years ago, I find no reason for changing the essential conception set forth in those chapters; nor is the need for changing it suggested to me by those on whose judgments I have the best reasons for relying.—H. S.

Royal Society Soirée

WITH reference to your account of the Royal Society's soirée (NATURE, vol. ix. p. 502), will you allow me to explain that all I "promised" concerning the missing pair of Paradise-birds was to deliver them when sent for.

They were not sent for, owing to some mistake, and consequently not exhibited.

May 5 P. L. SCLATER

Father Secchi's Work on the Sun

WITH great surprise I read in NATURE, vol. ix. p. 390, the following note:—

"Father Secchi is preparing at Gauthier Villars's second edition of his work on the Sun, on an enlarged scale. He has quoted so largely from Mr. Lockyer's 'Solar Physics' that an intended translation of this work is abandoned for the present."

I have the honour to inform you that the complete original of my second edition has been in the hands of M. Gauthier for more than a month, so far as that part which may have something in common with Mr. Lockyer's work is concerned, and that I had not seen Mr. Lockyer's work until a fortnight ago, when I bought it from M. Loescher here in Rome. Mr. Lockyer of course is quoted, but only from his original memoirs, and not from his new publication, nor in such a manner that his publication will render my work useless.

Rome, March 23 P. R. SECCHI

[The following explanation has been sent us by the Paris correspondent who furnished us with the note referred to by Father Secchi :—

"I was told by his (P. Secchi's) editor himself, when I spoke to him about publishing a French edition of Mr. Lockyer's 'Solar Physics,' the substance of what I have written to you. I think that the note I have written is a recommendation of Father Secchi's work; but not so his statement that he did not possess 'Solar Physics' until it was too late to use it. There is nothing whatever dishonourable in quotation."—ED.]

Spontaneous Generation Experiments

SINCE October 1870 I have, as opportunity offered and other work permitted, made a series of experiments bearing on the question of spontaneous generation. They seem to me to tell so plain a story that I am anxious to relate it.

The thoughts which led to the experiments were briefly these :—

The occasional or even frequent presence of living growths in fluids after they have been exposed to a temperature of 212° F. and are contained in closed tubes or flasks is rather an indication of the imperfection of a method than the proof of a theory; for under like circumstances living organisms ought either always or never to develop; the conditions being uniform, the results should be uniform.

When the tubes are closed at a blow-pipe flame after boiling, steam cannot be escaping from the aperture at the time of actual closure, and it is conceivable that in the momentary collapse of the contents which then occurs some atmospheric air containing organic matter may pass into the tube and invalidate the experiment.

The contained air, if any there be after the sealing of the tubes, must be vastly rarefied, and the ordinary atmospheric conditions, other than purity, which are essential, must be absent or greatly modified.

I attempted to devise an experiment which would be free from these possible sources of error; one in which the atmospheric pressure should be normal, in which the physical structure of the air should be unaltered, and in which there should be no chance of organic contamination after heating. Further it seemed a good thing to be able to show at the same time and in the same apparatus two distinct specimens of the boiled fluid, the one exposed only to cleaned air, the other exposed also to common air; and also to use a fluid which would indicate to the naked eye by change of colour, or of clearness, or of consistence, the time at which living growths made their appearance.

The latter condition was secured by using a fluid (for the idea of which I am indebted to Mr. Heisch's experiments on water-impurities) composed of 10 cc. of urine, 1 gramme of white sugar, and 90 cc. of distilled water. This when boiled and filtered is a clear transparent liquid, which becomes milky on the occurrence of organic growth during fermentation in thirty to forty hours, according to the heat to which it is exposed.

The other conditions were effected by using a glass tube of the shape of the capital letter M, with curved bends instead of the angles; a tube which may be described as having four straight legs joined to each other by two loops on the upper side and one on the lower; the first leg closed and the last leg open and short.

This tube, so bent, was made very hot, so as to expel as much air as possible from it; the open end was then plunged into the boiled and filtered urine-sugar fluid, and such a quantity allowed to flow in on the cooling of the tube as left the first, second, and third legs about half full when the tube was held upright. The tube was again heated to the boiling of the contained fluid in order to expel as much air as possible by the generation of steam. It was then allowed slowly to cool, so that the first leg was about one-third filled with fluid; and such an amount was left in the lower loop as would rise in the second and third legs to about the same extent as the tube cooled (and the cooling was designedly prolonged); air passed through the fluid in the lower loop to fill the space in the first upper loop, between the two masses of fluid, left vacant by the condensation of steam.

The tube was then hung up, away from direct sunlight, and exposed to the ordinary changes of temperature of my study.

If I have been able to describe intelligibly this very simple matter, it will be seen that I had here two portions of the same fluid separated from each other; both having been heated to the same temperature and both exposed to atmospheric air.

The conditions were precisely similar with one exception; intentional and crucial. The air in the first upper loop, to which air only the fluid in the first leg was exposed, had passed through and been washed by the fluid in the lower loop; and the fluid of this loop was on one side exposed to the washed air and on the other side to the ordinary atmosphere.

In experiments with this apparatus the phenomena were, in eight cases, as follows :—On the second or third day the fluid in the loop was milky, and the fluid in the first leg was bright. At the end of a week, a month, four months, indeed as long as the tube was kept, the one continued clear, the other was turbid. At the expiration of a time, varying in different experiments from four days to four months, I tilted over the least drop of the turbid fluid in the loop into the clear fluid in the first leg, when at once the milkiness began, and in a day the whole of the leg fluid was turbid also.

In many cases I examined the two fluids, clear and turbid, with a twelfth-inch object-glass, and found Bacteria in the turbid fluid; nothing in the clear fluid.

Twice I left (once unintentionally, once intentionally) so little fluid in the loop that, there being a small aperture, it did not fulfil its purpose as a filter and a valve, and in both cases the two masses of fluid became turbid at the same time.

In six other experiments I used urine; in four instances the loop fluid showed symptoms of putrefaction, and became turbid in four or five days, but the leg fluid remained clear. On the closure of the experiment, at varying periods from a week to four months, the bright urine appeared, on microscopic examination, to contain no organic growth, but underwent putrefaction as ordinary urine when exposed to the air.

In the two other experiments both urines putrefied at the same time. In one case I hastened the cooling by cold; in the other I left very little fluid in the loop.

In four experiments I used Dr. Charlton Bastian's turnip-cheese fluid. In all cases the solution was milky when made; twice it was filtered and twice unfiltered, and in all cases, when examined by the microscope after the lapse of some days or weeks, the fluid in both leg and loop contained organic growth.

The experiments on urine and urine-sugar fluid show, in my view, both positively and negatively, that there is something in the ordinary air which is a necessary condition of the origin of organic growth in these liquids.

Positively this position is demonstrated when, after six months, the fluid in contact with unwashed air is seen to be full of organic growth, and the fluid in contact with washed air is still unchanged.

Negatively it is supported when both fluids are seen to grow turbid at the same time from imperfect washing of the air, by reason of too rapid cooling or too scanty a supply of fluid for the washing.

The experiments with Dr. Bastian's turnip-cheese fluid were for some time a puzzle to me, and made me fear that there was an undetected fallacy in my other experiments. But now it is clear that the contradiction is only apparent. Dr. Burdon Sanderson has shown that this fluid contains within itself the elements of organic growth which are not destroyed at 212° F., the temperature at which my experiments were necessarily conducted.

I am anxious not to press these experiments unduly, but they seem to me to range themselves unequivocally in opposition to the theory of spontaneous generation; although they touch no great extent of the subject.

That the something in the ordinary air necessary for the origin of organic growth in the fluids used is a gaseous impurity of the air is supported by no fact of which I am aware; but whether it be living organised germ or dead unorganised matter, these experiments do not explain or attempt to explain.

LEONARD W. SEDGWICK

The Fertilisation of Fumariaceæ

IT was with great pleasure and interest that I read the communications from Mr. Darwin and Dr. Hermann Muller in NATURE, vol. ix. p. 460.

It so happens that, since writing the note on the tardy and apparently useless assumption of colour by *Fumaria capreolata* var. *pallidiflora*, I have chanced to see the flowers of this plant visited, on two occasions, by a bee in the daytime.

This insect was, on both occasions, I believe, a mason-bee, and certainly neither a hive nor a humble bee, and, as it confined its attentions to this one variety of fumitory, and was engaged for some time at its work, I had a favourable opportunity of watching the mode of operation.

The bee ranged from plant to plant, but, in every case, would only alight on and suck those flowers which, though still white, had assumed the horizontal position, these flowers alone affording a comfortable landing-stage for the insect.

The bee then clasped the lower part of the tube with its feet, and prized open the flower by thrusting its sheathed proboscis underneath the upper petal, when the tube split lengthwise, and gaped widely open, the style and stamens rising up and emerging from the cap formed by the inner petals, much as they do from the keel in many papilionaceous flowers, and rubbing against the underside of the bee's body.

I may observe that it is precisely in the short period during which the flower maintains itself in the horizontal position that the effusion of pollen takes place, and this coincidence of the plant bidding for the visits of insects at that particular moment has much the appearance of special adaptation.

But an examination of the flowers certainly shows that they are capable of self-fertilisation, and Dr. Hermann Muller tells us that Dr. Hildebrand states that this is habitually the case in *F. capreolata*.

I regret that I am only acquainted with Dr. Hildebrand's paper through a review which appeared in the *Bulletin* of the Société Botanique de France, where but few of the details are given.

I have not paid special attention to the structure and habits of the *Fumariaceæ*, and I am therefore unable to say whether the plant to which I have alluded is commonly visited by insects in the daytime, or whether, as Mr. Darwin suggests, its flowers, the nearly white colour of which would render them peculiarly conspicuous in the dusk, may not prove especially attractive to moths and other night-fliers.

While watching the bee whose operations are described above, I noted with interest that it confined its attention exclusively to plants of this single variety of fumitory, winding its way through flowering masses of other fumitories and weeds.

In the same way a honey-bee, at the same spot on a later day, exclusively visited the wild mignonette (*Reseda phyteuma*), passing by the fumitories, marigolds, &c.

J. TRAHERNE MOGGRIDGE

Maison Gastaldy, Mentone, April 20

ALLOW me shortly to resume the different views which have been proposed in your columns, as giving a possible explanation of the fact that the flowers of *F. pallidiflora* attain their brightest colouring when the time for fertilisation has passed, and to point out the observations indispensable to be made, in order to ascertain which of the proposed views is right. 1. It is possible that nocturnal Lepidoptera are the fertilisers of the fumitory; in this case it would be most probable that the pale colour of its flowers has been acquired by natural selection, pale flowers being most conspicuous in the dusk. 2. Diurnal insects may be the fertilisers, and the pale hue may be sufficiently conspicuous or even more attractive for them than the brighter one. In this case, also, the former must be considered as acquired by natural selection; the latter, on the contrary, as in the first case, merely as the result of chemical processes. 3. Under the same supposition of diurnal insects being the fertilisers, it is possible that the older flowers, by their brighter hue, serve to attract insects to the younger and paler ones; in this case the bright hue of the older flowers may be looked upon as acquired under the influence of natural selection, the pale colour of the younger flowers at the same time being useless. 4. It is possible that self-fertilisation is the rule with the flowers of this fumitory, and that cross-fertilisation by insects takes place only very exceptionally; in this case not only, as in No. 3, the paler colour, but also the brighter one would be nearly independent of the influence of natural selection. In order to decide definitely which of these views is right, it is indispensable to watch perseveringly the flower of this plant, and to ascertain what kind of fertilisation naturally takes place. In case diurnal insects should prove by direct observation to be the fertilisers, it would be possible to decide whether supposition 2 or 3 is correct, by removing from many specimens every older flower as soon as its colour begins to grow brighter, and by observing whether these specimens or those with older and brighter flowers are more frequently visited by insects.

It would be a great pleasure to me to make these observations, but I do not know whence seeds of *Fumaria pallidiflora* can be obtained. Perhaps some reader of this letter may be good enough to give me information on this point.

Lippstadt, April 28 HERMANN MÜLLER

MR. COMBER'S suggestion (vol. ix. p. 484) that the coloured flowers of *Fumaria* attract insects to the uncoloured ones is very ingenious. Supposing that they are cross-fertilised, the case of *Poinsettia* is very pertinent, and is enforced by that of *Dalechampia*, also euphorbiaceous, in which the bracts, a beautiful rose colour before fertilisation, gradually assume afterwards the same green hue as the foliage when the bright colour is no longer needed. The chemical changes that take place in the flower at and after the period of its complete expansion must necessarily be complex, as well as varied in different cases. Rapid oxidation is probably one very effective agent in producing them, but the results will necessarily depend on what is operated upon. *Hibiscus mutabilis* is white in the morning, deep red by night. Species of *Lantana*, like *Myosotis versicolor*, pass through a whole series of colours as they expand. On the other hand all the beautiful species of *Franciscea* rapidly lose the tints with which their flowers open, and become nearly white. The final stages in the life of all the parts of the flower which are not accessory to the formation of the fruit are more or less processes of decay, and there is no absolute law that these should always be accompanied by inconspicuous or displeasing tints. The white flowers of *Calanthe veratrifolia* blacken when they are bruised; on the other hand, according to Kingsley, the crimson flowers of *Couroupita guianensis* turn blue when torn, as the pulp of the fruit is also known to do on exposure to the air. In the same way some fungi exhibit when bruised striking tints which yet can be of no service to them. *Agaricus georginæ* changes from snow-white to blood-red wherever it is touched, and the white flesh of *Boletus cyanescens* when broken changes instantly to the "most beautiful azure blue."

In fact if a chemical change is set up—if it produces a change of tint at all—it must *sometimes* produce a pleasing one; that it should do so is not necessarily advantageous to the plant, though open to be taken advantage of by it.

W. T. THISELTON DYER

Fertilisation of Corydalis claviculata

WITH regard to the flowers of *Corydalis claviculata* (of the discovery of which species in this neighbourhood I have sent a note to the *Journal of Botany*), I think Mr. Bennett (vol. ix. p. 484) will find his suspicion that the styles may have been broken off in dissecting to be correct. This may easily be shown by floating off in water the petals, &c., of a withered flower, in which the process of fertilisation has been completed, when the style will be seen adhering to the ovary, though the gentlest touch will be sufficient to separate it. In the bud the anthers cover the stigma, but at the time of maturity the latter projects slightly, so that it would be first touched by the proboscis of an insect. I suspect that it is also slightly protogynous, though self-fertilisation may probably be of frequent occurrence. The manner in which the style is embraced by the stamens and petals protects it from too rough a shock from the struggles of insects in the narrow entrance to the flower. I have not, however, observed them to visit it.

W. E. HART

Kilderry, co. Donegal, April 28

Lakes with two Outfalls

SINCE writing my letter of April 24, with which I forwarded a copy of the new Inch Ordnance map of Arran, I have received other copies from Mr. Stanford, showing, as I presume, that the early copies of General Sir H. James's admirable work have been revised. For, besides the elaborate system of contour lines, which did not appear in the first copies, *two* outlets are given to Loch-na-Davie, instead of one only. So that, as to the "matter of fact" touching the new Inch Ordnance map, Mr. Christie and I are both right. That is, he has a copy to show for his assertion; I have one to show for mine. But the great question is not what is the "matter of fact" as touching maps, but what is the matter of fact in nature; and I assert that Loch-na-Davie has but one outlet, to the south, to Glen Iorsa. My words in the *Athenæum* are—"The water-parting is a few yards to the north of the loch, I should *guess* at the spot where a heap of stones stands, apparently lately thrown up;" and from there there is a slight trickling *inlet* to the loch. I ended my letter thus—"Most gracious reader of the *Athenæum*, go take a tourist ticket to Glasgow from Euston Square. Then a lovely run in a Clyde steamer to Arran, and *judge for yourself.*" May I repeat this advice to the "gracious reader" of NATURE, for assuredly there is no *arguing* as to a "matter of fact."

As a matter of opinion, I do not think that any quantity of rain could turn the northern inlet into an outlet. That is, I think that at the southern end there is room to emit any overflow before the northern end could be flooded. Mr. Christie seems to suppose a constant double outlet. Dr. Bryce, more modest, only claims this in "winter and wet summers" (3rd edition, p. 3), or "when it rises about eighteen inches above its level in dry weather" (p. 130).

Alresford, May 1 GEORGE GREENWOOD

I OBSERVE that a correspondence has been going on in the columns of NATURE on the subject of lakes with double outlets. It may interest your readers to learn that some glaciers afford instances of the same phenomenon. One of the most remarkable of these is the Glacier d'Arsine, in the old French province of Dauphiné (now the Département des Hautes Alpes). This glacier is broad and short; its moraines are extraordinarily large. It ends just on the watershed between the Romanche and Guizanne, and consequently streams flow from it in both directions. On one side, the stream forms a branch of the Romanche, which fall into the Drac, the united stream entering the Isère below Grenoble. On the other side, the stream flows down to the Guizanne, which, after receiving the Clarée near Briançon, assumes the name of the Durance, and falls into the Rhone below Avignon. This watershed is a prolongation of that over which the magnificent route impériále (magnificent in point of engineering and of scenery) of the Col du Lautaret has been carried. Thus glacier is very rarely visited, though the above-mentioned phenomenon has been remarked before. Perhaps some of your readers can supply the names of other glaciers which present a similar phenomenon. I need only add that these observations were made during personal visits to the Glacier d'Arsine on July 15 and 17, 1873.

Exeter College, Oxford W. A. B. COOLIDGE

Trees "Pierced" by other Trees

THE natural phenomenon of one tree within another is very frequently witnessed in India in the case of the "pípal" (vulg. *pepul*) and the palmyra. The first instance which drew my attention to it was one in which a very large specimen of the former with a stem some 4 ft. thick was surmounted by a towering palm which *seemed* to grow out of, and in continuation of, the solid trunk at a height of about 30 ft., and rose to a height of 30 to 40 ft. more. I speak from recollection only. An amicable dispute took place between two natives, of whom I inquired about it—both strangers to the locality—the one declaring that the palm grew up *inside* the tree from the ground, and the other that it grew *upon* it. Subsequently I saw numbers of others in all stages, and recognised the fact that the fig grows up by the side of the palm and gradually *encloses* it, so completely as to defy examination of the resulting trunk. The tree that I speak of was by far the most remarkable specimen of the kind, and therefore I give its locality. It is a little south of the town of Kodangal, in the Hyderabad country, long. 77° 40′ E., lat. 17° 6′ N. J. HERSCHEL

May 5

COLONEL GREENWOOD's solution of the beech-tree pierced by a thorn plant is undoubtedly correct. The New Forest affords many cases of the branches of that tree growing together and forming holes apparently through the trunk. Ivy gives the most striking and familiar examples of its runners crossing and uniting; it is not unusual to find a triangular arrangement of runners which cross each other at intervals of a few inches apart. It may be as well to draw your readers' attention to the spasmodic way in which the leaves of the beech burst in spring: sometimes an entire branch, at others a single twig with less than twenty leaves, will be in full leaf a week or ten days before the buds have generally burst. G. H. H.

IN reference to this subject I many years ago met with an instance of a birch growing out of the fork of an oak.

The trunk of the oak at perhaps 8 ft. or 9 ft. from the ground divided into two large arms from between which a birch sprung. The oak was of very considerable age but apparently was not hollow (of this, however, I am not positive). The birch was perhaps 12 ft. or 14 ft. high. P. P. C.

The Antipathy of Spiders to the Wood of the Spanish Chestnut

CAN any of your readers establish the truth of the following assertion? Spiders' webs are never found upon beams from the Spanish or sweet chestnut tree, even when the timber is several centuries old. The keeper of the ruins of Beaulieu Abbey, in Hampshire, asserts that this is a fact, and the buildings of the Abbey, where beams of Spanish chestnut are used, are free from the invasion of spiders. His attention was drawn to this four years ago, and since then his observations have not thrown any doubt upon its accuracy.

Birkenhead, April 23 G. H. H.

FLOWERS OF THE PRIMROSE DESTROYED BY BIRDS

WE have received several additional letters on this subject, the important statements in which we have brought together here, in continuation of last week's article (vol. ix. p. 509).

Prof. Newton of Cambridge, in reference to Prof. Thiselton Dyer's letter of last week, writes as follows:—

> Allow me to remark that the observation of Gilbert White (quoted by Prof. Dyer in NATURE, vol. ix., p. 509) respecting the bird said to "sip the liquor which stands in the nectarium" of the crown-imperial, has not, so far as I know, been confirmed by anyone else. Yielding to no man in my general trust in White's wonderful accuracy, I think that here we ought to suspend our belief, caution being perhaps the more needed, since, as has been pointed out by several of his editors, it is almost certain that the bird he saw was not the bird he supposed it to be.

Major E. R. Festing writes:—

> A month ago I saw a caged hen bullfinch that would treat any quantity of primroses which were given to her in precisely the way described by Mr. Darwin in NATURE, vol. ix. p. 482. She gave one snip only to each flower, not again touching the remains of it, which fell to the floor of the cage.
>
> My experience in trying to keep a small garden in London some years ago was, that the yellow crocus flowers were always destroyed by the sparrows as soon as they come into full bloom, no doubt with the same object as the finches have in destroying primroses. I do not remember that the purple or white flowers suffered in the same way.

A correspondent, dating from Exeter College, Oxford, writes as follows:—

> Your article on the destruction of primroses brought to my mind several facts which came under my notice lately in a manse-garden in the south of Scotland. Under a cherry-tree the ground was thickly planted with primroses, all the flowers of which were picked by the sparrows. As not only was this cherry-tree in flower at the time, but there was also a good show of flower on the various other fruit-trees in the garden, in this instance, at least, the flowers of the fruit-trees seem not to have exercised a superior attraction.
>
> Again, I myself saw that the work was done by sparrows.
>
> Another writer in your article asks, if any other birds besides sparrows have been seen to use fresh flowers in nest-building? In this same manse-garden, some weeks ago, I watched some jackdaws busily plucking and carrying to their nests in a neighbouring chimney the leaves, flowers, and stalks of a variegated form of the common *Glechoma hederacea*.

Mr. J. Southwell states that in his garden in the suburbs of Norwich, the yellow crocuses are yearly destroyed by sparrows. He says:—

> Formerly I have seen these mischievous birds pulling

the petals in pieces and scattering them on the ground, to enable them to reach the nectary, which is situated about on a level with the soil; but of late they have altered their tactics and simply bruised the perianth tube sufficiently to extract the nectar, leaving the bloom uninjured but fallen over as though killed by severe frost. The primroses have hitherto escaped, but this spring for the first time the sparrows have attacked the blooms of a cherry-tree, bruising the nectary between their mandibles, and generally detaching the blossom from the foot-stalk close to the calyx. That in both cases this is the work of sparrows I have had ample opportunities of observing. Some years ago a border of Virginian stock which was in full bloom appeared mysteriously to be growing thinner every day. I accidentally saw from a window the sparrows vigorously engaged in pulling up the plants, which they could only do by great exertion, and flying off with them to form their nests. This lasted till the whole were carried away. The fact of the sparrows having altered their form of attack on the crocuses, going direct to the nectary instead of pulling the flowers to pieces, would seem to indicate that the habit is acquired, and not inherited; it also appears, so far as I can learn, to be an increasing habit with them.

Mr. A. F. Buxton, of Cambridge, has frequently observed the same fact about primroses in a wood near Ware. He says:—

> I could give no satisfactory explanation of the phenomenon, if it were not that I have noticed the propensity of tame bullfinches to act in the same way towards flowers, especially primroses. In the wood I speak of, bullfinches are abundant; but whether or not they are the only birds which act thus I am of course unable to decide.

Mr. W. E. Hart, of Kilderry, co. Donegal, states that the primroses there suffer much every spring in the manner described by Mr. Darwin. The cowslips and oxlips are seldom, if ever, touched. Mr. Hart says:—

> The blame is commonly laid upon the chaffinch, though I have only been able to gather circumstantial evidence against it. I have frequently disturbed both chaffinches and greenfinches from primrose-beds, and found the cut-off flowers strewn about. One lady tells me that she once saw a thrush deliberately cut off a number of primrose flowers in her garden, turning each time to stare defiantly at her. Another has frequently seen hedge-sparrows do so. Thus it appears that several different species of birds have acquired the same habit.

J. M. M. has cultivated polyanthuses at Sidmouth, South Devon, for seven or eight years, and each year they have been more or less destroyed by birds, as described by Mr. Darwin. She does not remember to have noticed it till she came to Sidmouth. The wild primroses suffer also, but not, she thinks, to any great extent, though they are abundant in the neighbourhood.

Another correspondent, writing from Poplar, informs us that many years ago he became aware of the fact that flowers containing nectar are attacked by some small animal; having had a bed of crocuses in his garden, the flowers of which were morning after morning destroyed by, he believes, the sharp bills of the sparrows. He, however, suggests that mice frequently might have been the depredators, "as last year," he says, "they destroyed all the grapes in my greenhouse. They are just able to reach such flowers as the crocus and primrose, and they are very hard up at the early season when these delights appear."

M. T. M. mentions, "on the authority of a good observer," that the flowers of the laburnum are sometimes utilised in nest-building by suburban sparrows, "whose destructive habits in the matter of crocuses," he says, "are only too well known to suburban gardeners."

Mr. C. H. Beasley, of Liverpool, writes, that he had a canary some years ago which was particularly fond of primroses, and always bit them in the manner described by Mr. Darwin, usually leaving everything but the part containing the honey untouched. As this peculiarity was exhibited by a domesticated bird, he thinks it highly probable that it was inherited.

THE LECTURES AT THE ZOOLOGICAL SOCIETY'S GARDENS

III.

MR. SCLATER commenced his fifth and concluding lecture on the geographical distribution of the mammalia, by impressing the importance of precise definition of the exact localities from which zoological specimens are obtained. He showed that by further careful collecting, new animals, even of considerable size, most probably remain to be discovered, considering that a previously unknown rhinoceros and a fresh genus of deer had been made known within the last three years.

The importance of the geographical distribution of the larger divisions of the mammalia is well illustrated in the case of the *Bassaris* of Mexico, an animal supposed for a long time to belong to the civet cats, which are peculiar to the Ethiopian and Indian regions, but now known in its internal structure to agree with the racoons, which are typically American forms. So also the so-called musk deer are often said to inhabit northern Asia, India, and Africa, but there is only a single species of the true musk deer, which is from northern Asia, whilst the Tragulidæ (with which it has been erroneously united) form quite an independent group, found in India and Africa.

The facts given in the preceding lectures suggest the question as to how the world may be most naturally divided according to the distribution of the animal life upon it, which is part of the great problem of the distribution of organic life generally; and it is evident that all great deductions made from any one group must in the long run correspond with those from other groups.

At the outset it is evident that the ordinary geographical divisions of the world do not hold. Europe must be combined with the northern part of Asia, and also with Africa north of the Atlas Mountains. In the same way central America and part of Mexico have to be included with South America. Taking the division of the mammalia into Monodelphs, Didelphs, and Ornithodelphs, the peculiarities of their distribution are very instructive: dividing the surface of the earth into four major divisions —1. *Arctogæa*, or North Land; 2. *Dendrogæa*, or Tree Land; 3. *Antarctogæa*, or South Land; and *Ornithogæa*, or Bird Land.

Arctogæa is divisible into four minor regions—(α) the Palæarctic, (β) the Ethiopian, with the Lemurian subregion of Madagascar, (γ) the Indian, and (δ) the Nearctic. The Palæarctic region possesses few characteristic families and genera. Its boundaries, as are those of all regions except when sea-bound, are ill-defined; Palestine, for example, is doubtful. Quadrumana are almost entirely absent; *Rhinopithecus*, a Thibetan form, belonging, apparently, to the region. The genera *Ælurus* and *Capra* are characteristic forms. Bears are mostly confined to it, some being, however, found in North America and one in South America. Among the Ungulata, the genus *Equus* is more truly Palæarctic than otherwise, and *Cervi* are abundant.

The Ethiopian region embraces Africa south of the Sahara. The genera Troglodytes, Colobus, Cercopithecus, and Cynocephalus are characteristic, as are Hyæna, Proteles, Lycaon, Hippopotamus, Camelopardus, and others. Madagascar forms a well-marked sub-region, containing no antelopes nor cats, but Lemur, Chiromys, and Cryptoprocta. It is the true home of the lion.

The Indian region extends along Southern Asia to Wallace's line in the Malay Archipelago. The only ruminant animal in the Indian Archipelago is the peculiar *Anoa depressicornis*.

The Nearctic region is very much like the Palæarctic. Castor, Gulo, and Lynx are common to the two. Taxidea, Procyon, and Antilocapra are characteristic, whilst Didelphys has entered from the south.

The Neotropical region (*Dendrogæa*) possesses great individuality, Cebus, Hepale, Icticyon, Nasua, and

Cercoleptes being characteristic. Hystricidæ abound, and Ruminants are very badly represented, only lamas, peccaries, and tapirs being found. Sloths, armadillos, and opossums are not found elsewhere, and there are no frugivorous bats, Insectivores, Viverridæ, nor elephants. The West India Islands form a well-marked (Antillean) sub-region, possessing Solenodon, and peculiar Rodents.

The Australian region, including Australia and the Malay Archipelago up to Wallace's line (or *Antarctogæa*), is characterised by the presence of the Monotremes and Marsupials. Lastly New Zealand (*Ornithogæa*) has no Mammals at all except two Bats.

Mr. Sclater, in conclusion, explained the different answers which had been given to the question: Why are animals thus distributed? showing that the Darwinian hypothesis is a key to the whole subject, rendering quite simple most of those difficulties which were previously insurmountable.

CAMPHOR

THE camphor of commerce, it is well known, is the produce of *Camphora officinarum* Nees., a tree of China and Japan. To obtain it the wood is cut up into pieces and boiled in water, when the camphor is deposited. It is afterwards purified by sublimation, and further refined after its arrival in this country. Immense quantities of this article are imported from Singapore, and though so valuable in European commerce, in Sumatra and Borneo a much higher value is put upon that known as Sumatra camphor, which is obtained from *Dryobalanops aromatica* Gaert. (*D. camphora* Coll.), which does not come to this country as an article of trade. Besides these there is a third kind of camphor, known in China as Ngai camphor; this, in point of value, stands between the ordinary commercial article and the Malayan or Sumatra camphor. Its botanical source has for a long time been doubtful, but it has generally been attributed to an unknown species of *Artemisia*. Mr. D. Hanbury, however, who has done so much in clearing up doubts on the botany of many of our important articles of trade, more especially in relation to drugs, has recently, in a paper read before the Pharmaceutical Society, identified the plant with *Blumea balsamifera* D.C. It is a tall, herbaceous plant, and has long been known for the powerful smell of camphor emitted from the leaves when bruised. It is common in Assam and Burma, and indeed throughout the Indian islands.

The materials from which Mr. Hanbury has been enabled to solve the problem of the origin of this peculiar camphor were sent him from Canton, and consisted of a small branch of the plant, and specimens of the camphor itself. These specimens, he says, "represented two forms of the camphor—the one a perfectly colourless crystalline substance, in flattish pieces as much as an inch in length;" the other, which was sent as crude camphor, was a crystalline powder of a dirty white colour, mixed with some fragments of vegetable tissue. "The purer sample has an odour scarcely distinguishable from that of ordinary camphor; but the odour of the other is perceptibly contaminated with a smell like that of wormwood." This camphor, though seldom seen in this country, was at one time attempted to be brought into commerce, one hundred pounds of it having been made in Calcutta. It is used in the East, both in medicine and in the manufacture of the scented Chinese inks. It is stated that "about 15,000 dols.' (3,000*l.*) worth is annually exported from Canton to Shanghai and Ningpo, whence it finds its way to the ink-factories of Wei-chau and other places."

Though it is now proved that *B. balsamifera* is the plant yielding the bulk of Ngai camphor, it is not improbable that some other plants lend their aid, for the term "Ngai" is, it appears, applied to several belonging to the Labiatæ and Compositæ. JOHN R. JACKSON

THE "SPAR CAVES" OF THE NORTH BRIDGE, EDINBURGH

THE North Bridge, which spans the deep valley lying between the Old and New Towns of Edinburgh, was built upwards of a hundred years ago, and its huge arches must be familiar to all who have entered Edinburgh from the south by railway, the terminus for the main southern lines being situated just below. Between the arches of the bridge and the roadway above are a number of chambers or vaults which have not been opened, till recently, since the bridge was built. In carrying out the operations necessary for the widening of the now too narrow bridge, these vaulted chambers have been opened up, and one of them has been visited by Prof. Geikie, who, in a communication to the *Scotsman*, describes the wonderful sights he saw.

"The chamber we examined," he says, "was about eight or ten feet broad, and varied in height according to the rise and fall of the floor over the arch underneath, the floor coming sometimes so near the roof that we needed to stoop low to get through. From the vaulted ceiling, and especially from the joints of the masonry, hung hundreds of 'stalactites'—delicate spar icicles of snowy whiteness. In many cases they reached to the floor, forming slender thread-like pillars. In making our way we were under the necessity of brushing down many of these pendant masses. Now and then we seemed to be marching through a grove of white and brittle canes. The longest entire one we could see measured rather more than six feet in length. Usually they were slim stalks somewhat like thick and not very well-made tobacco-pipes, but towards the sides of the vaults they became thicker and stronger, one which we carried off measuring about four feet in length, and as stout as an ordinary walking-stick. The same material as that forming the stalactites spread in ribbed sheets down the sides of the vault. The floor, too, was dotted all over with little monticules of the same snow-white crystalline spar.

"A more illustrative example of a stalactitic cavern could not be found. The whole process was laid open before us in all its stages. Along the joints of the masonry overhead could be seen here and there a drop of clear water ready to fall. At other places the drop hung by the end of a tiny white stone icicle, to which it was adding its own minute contribution as it evaporated. From the mere rudimentary stumps the stalactites could be traced of all lengths until they were found firmly united to the spar hillocks on the floor. Every one of these hillocks, too, lay directly beneath the drip, catching the remainder of the stone dissolved in the dropping and evaporating water. In every case the stalactites were tubes; even the thickest of them, though it had undergone great changes from deposit on its outer surface, retained, nevertheless, its bore. Usually there hung a clear water-drop from the end of the stalk, ready to descend upon its white stony mound beneath.

"So far, except for the undisturbed perfection of the whole, there was nothing which may not be seen under many an old vault. But what astonished me most was the evidence of a continuous growth and destruction of these slim stalks of stone during an actually known period. In a great many cases the little 'stalagmite' mounds were each surmounted by a short slender stalk, as the Calton Hill is by Nelson's monument. There could be no doubt that these monumental-looking objects were merely the lower ends of once-continuous stalactite pillars. And indeed, searching round the mound I could usually find fragments of the broken column imbedded in the growing stalagmite. What had broken them? Perhaps a heavy omnibus thundering overhead, or a laden lorry or a deftly-fired royal salute. Anyhow, for a hundred years this delicate tapestry has been hanging and growing, and breaking and growing again, quietly in darkness, beneath the grind of our carriage wheels, and yet high in air, with the stream of human life flowing underneath it too. Alike in the pendant stalks, on the walls, and in the mounds on the floor, the prevailing colour of the crystalline incrustation is pure white. These caves in middle air have been shut up from the contamination from town smoke. Now and then, however, the dripping water has come upon soluble iron as well as lime. Hence the mounds on the floor are sometimes curiously coloured yellow, brown, and red.

"As the bridge is built of sandstone, wholly or almost wholly free from lime, it is evident that the material which has converted these vaults into such picturesque caverns has been derived from the mortar. All rain-water, as is well known, takes up a little carbonic acid from the air; and of that acid there is in the air of a town usually more than the normal proportion. Filtering through the masonry, it dissolves the lime, carrying it downward in solution, and, if made to halt and evaporate, depositing it again in the form of the white crystalline substance which we call spar. It would be a curious question for the architect how long his masonry could resist this action. Certainly, in spite of what these vaults in the North Bridge reveal, the masonry of that structure is to all appearance as solid and firm as ever. It is evidently impossible, however, that the mortar, if necessary at all, can be piecemeal removed without in the end causing the destruction of a building."

*REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"**

III.

IN the types already considered, the exo-skeleton consists of small placoid scales having the structure of teeth, and imbedded in the skin, but being altogether irrelative to the true cartilaginous endo-skeleton. In the group of fishes which form so perfect a mean between these Elamobranchs and the osseous fish—the Ganoids—the body is covered with close-set "ganoid" scales, which consist of two layers, a deeper one of bone (dermostosis), and a superficial one of enamel, covered only by a thin layer of epidermis. In the head these scales pass insensibly into a set of bones in close relation with the chondro-cranium, and having the connections, positions, &c. which characterise the roofing-bones of one of the higher skulls (parietals, frontals, nasals, &c.). In many cases these bones are so deeply imbedded in the subcutaneous tissue as to deserve the name rather of parostoses than of dermostoses, but are always easily removed by maceration or boiling. They are evidently of an entirely different nature to another series found in the same skulls, but in intimate connection with the cartilage, and only separable by its entire destruction. These last are ossifications of the chondro-cranium, and are often spoken of as "cartilage-bones;" the former kind have only a secondary relation to the primordial skull, and are known as "membrane-bones."

In the osseous fish both these varieties of bone appear, but the investing or membrane-bones are all true parostoses developed in the deeper subcutaneous tissue, and the place of the ganoid dermostoses is taken by cycloid or ctenoid scales. Still the insensible gradation between scales and skull-bones is very apparent: along the side of the trunk passes a series of curious tubular or grooved bones containing mucous glands and known as the "lateral line series;" these, on reaching the head, branch out so as to produce a tree-like arrangement instead of a single row, and the burrowing is now, not in a series of modified scales, but in true cranial bones, some belonging to the opercular apparatus, some to the series above and below the eye.

IV.—*Skull of the Salmon* (Salmo salar).—In the Teleostean the investing bones attain a greater development than in any other group, and, in the description of the salmon's skull, will be considered before the cartilage-bones which they overlie, and from which they come away with great ease by maceration.

There are, in the first place, on the upper surface of the skull, three pairs of bones and a single median ossification. Of these, a pair of small bones, separated from one another by a considerable interval, and lying over the auditory region, answer to the parietals (Fig. 7, Pa); a much larger pair roofing over all the central portion of the brain case, from the parietals behind to the nasal region in front, are the frontals (Fr); and a very small and insignificant pair situated just above the nasal sacs the nasals (Na). All these are well known from their occurrence in the higher animals; but the bone marked S.Eth (super-ethmoid), which lies between the nasals and over the cartilage separating the olfactory organs, is peculiar to certain osseous fishes.

Above the eye is a small bone, known as the supra-orbital (S.Or), and below and at its sides a chain of bones, deeply excavated by slime-glands, the sub-orbitals (Sb.Or); the most anterior of these (Lch) seems to answer to the lachrymal bone of the higher animals. The gape of the mouth, instead of being formed, as in the shark and ray, by the naked pterygo-palatine and Meckelian cartilages, is bounded entirely by membrane-bones, three in the upper jaw, the pre-maxilla (Pmx), maxilla (Mx), and malar or jugal (Ju), and one in the lower, ensheathing Meckel's cartilage, the dentary (D). The maxilla, unlike that of most typical Teleosteans is dentigerous, and takes a large share in the formation of the gape. Immediately below the angle of the lower jaw is situated a small bone, the angular (Ang).

Two very important parostoses occur on the under surface of the skull, where they clamp and strengthen the cartilage; these are the vomer (Fig. 8, Vo), which bears a few teeth, and the para-sphenoid (Pa.S), the enormous development of which is so characteristic of the bony Ichthyspsida.

Lastly there are the bones supporting the gill-cover, or operculum proper, and branchiostegal membrane, each of which has its own set of osseous strengthenings. In the first set are included the opercular (Op), sub-opercular (S.Op), pre-opercular (P.Op), and inter-opercular (I.Op); in the second, the branchiostegal rays (Brs.R). The operculars are also divisible into two categories; two of them—the pre- and inter-opercular—are developed in the fold of skin growing from the mandibular arch, which covers the cleft (existing only in the embryo) between it and the hyoid (Fig. 1, p. 425, Ty.Eu), while the remaining two belong in like manner to the operculum of the hyoid arch covering the branchial slits (Fig. 1, Cl'). The pre-opercular is interesting as being the homologue of the lower part of the mammalian squamosal, and the inter-opercular as representing the tympanic, the two membrane-developed ossifications of the complex temporal bone of human anatomy. The branchiostegal rays are flat sabre-like bones, twelve in number, attached to the hinder edge of the hyoid apparatus. In most Teleostei these bones are seven slender terete rays, the four upper of which are attached to the outer and the three lower to the inner side of the hyoid. At the point where the branchiostegal membranes of opposite sides meet below the throat a median ossification is developed in the subcutaneous tissue; this is the so-called uro-hyal, or basi-branchiostegal (B.Brs).

---

* Continued from vol. ix. p. 468.

When all the foregoing bones are stripped off, the salmon's skull is far more comparable than in its perfect state with that of an Elamobranch, being reduced to the chondro-cranium, a cartilaginous structure, with certain endogenous ossifications, but retaining to a remarkable extent the characters of a "primordial skull." A side view of the chondro-cranium is shown in Fig. 9: viewed from above it presents, like that of the ray, expanded sense capsules, and a narrowed inter-orbital region; the walls of the brain-case are, however, much thicker, and its cavity relatively smaller than in the preceding type (see Fig. 8); the rostrum also is short, and the roof of the skull or tegmen cranii produced into a strong ridge (culmen cranii). The end of the snout divides into two short processes (hypo-trabeculars, H.Tr), on each of which two labial cartilages are borne (l^1, l^2).

The bones developed in the chondro-cranium of the salmon very rarely come together so as to form sutures, but are usually separated by considerable tracts of cartilage or synchondroses. Ankylosis only takes place in the case of a single pair of bones—the orbito-sphenoids—which are fused together in the mid-line, so as to form a structure not unlike the "girdle-bone" of the frog.

Fig. 7.

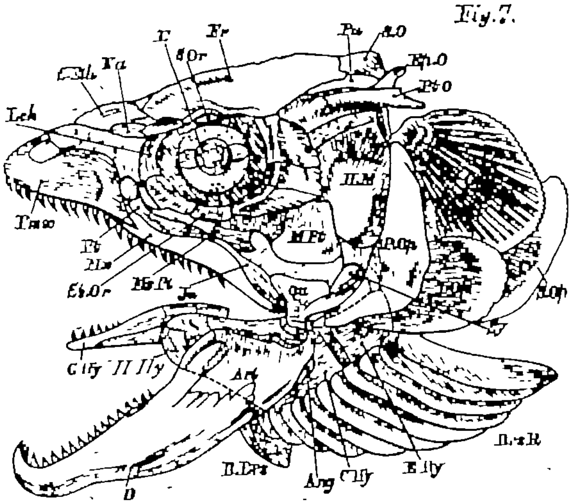


FIG. 7.—Skull of Salmon. Pa, parietal; Fr, frontal; Na, nasal; S.Eth, supra-ethmoidal; S.Or, supra-orbital; Sb.Or, sub-orbitals; Lch, lachrymal; Pmx, pre-maxilla; Mx, maxilla; Ju, jugal; D, dentary; Ang, angular; Op, opercular; S.Op, sub-opercular; I.Op, inter-opercular; P.Op, pre-opercular; Brs R, branchiostegal rays; B.Brs, basi-branchiostegal; S.O, supra-occipital; Ep.O, epiotic; Pt.O, pterotic; Pl, palatine; Ms.Pt, meso-pterygoid; Art, articular; Sy, symplectic; G.Hy, glosso-hyal. The cartilaginous parts are dotted.

The hinder or occipital region of the skull is ossified by four bones, which surround the foramen magnum, and together form the "occipital segment;" these are the basi-occipital (Figs. 8 and 9, B.O) below, the exoccipitals (E.O) at the sides, and the supra-occipitals (S.O) above. The first of these bears a concave surface or condyle (O.C) for articulation with the first vertebra, the space between the two being filled up with the remains of the notochord. The auditory capsules are strengthened by no less than five bones: the prootic (Pr.O) formed in the anterior part of the capsule; the opisthotic (Op.O) over the ampulla, and the epiotic (Ep.O) over the arch of the posterior semicircular canal; the pterotic (Pt.O) over the arch and ampulla of the horizontal, and the sphenotic (Sp.O) over the ampulla of the anterior canal. The prootics of opposite sides meet in the mid-line (Fig. 8), and form a bridge of bone on the base of the skull, in front of the basi-occipital. Anterior to this "prootic bridge," and completing the basis cranii, is a small bone, Y-shaped in section, the basi-sphenoid (B.S), which, curiously enough, has no cartilaginous predecessor, but is ossified directly from membrane. Above this bone, and in front of the sphenotic, the ali-sphenoids (As) are found in the side-walls of the brain-case, and, together with the basi-sphenoid below and the parietals above, form the "parietal segment" of the skull. The "frontal segment" has no basal element, the pre-sphenoid being absent, but its side-pieces are represented by the coalesced orbito-sphenoids (O.S) The only remaining bone in the skull proper is the large lateral ethmoid (L.Eth), which occurs immediately behind the depression for the nasal sac (Na).

Certain very constant relations exist between these bones and the cranial nerves. The trigeminal (V.), for instance, always determines the prootic, as its third division makes its exit just in front of that bone, or, in other words, between the anterior boundary of the auditory capsule and the parietal segment. The glosso-pharyngeal and vagus (IX. and X.) in like manner limit the posterior boundary of the ear capsule, passing out either between it and the exoccipital, or through the front part of the latter. The optic nerve (II.) passes between the parietal and frontal segments, usually being bounded in front by the orbito-sphenoid, and behind by the orbito-sphenoid. In the salmon a bar of bone grows across the trigeminal notch of the prootic, so that part of the nerve passes through a complete foramen.

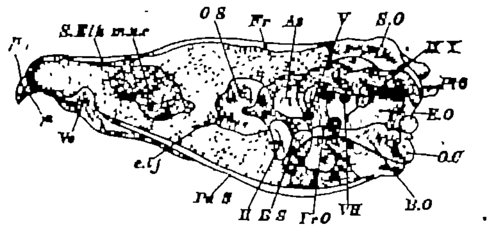


FIG. 8.—Longitudinal section of Salmon's Skull. Pa.S, para-sphenoid; Vo, vomer; B.O, basi-occipital; E.O, exoccipital; Pr.O, prootic; B.S, basi-sphenoid; As, ali-sphenoid; O.S, orbito-sphenoid; O.C, occipital condyle; l^1, l^2, labial cartilages; m.n.c, middle nasal cavity; e.t.f, ethmo-trabecular fissure.

An interesting instance of the retention of embryonic characters is seen in the slit marked e.t.f in the sectional view, Fig. 8. This is a fissure in the otherwise solid cartilage running forwards for a short distance from the lower anterior angle of the orbito-sphenoid, and indicating the line of separation between the trabecular portion of the skull and the part produced by the chondrification of its originally membranous walls; this structure is called the ethmo-trabecular fissure. In front of and above this fissure is a large cavity (m.n.c) filled with fat, and opening on the surface of the chondro-cranium beneath the supra-ethmoidal bone; there is no doubt that this seemingly useless space represents the single nasal chamber of the lamprey or hag.

Fig. 9.

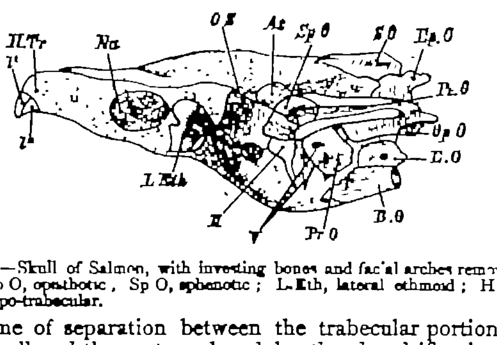


FIG. 9.—Skull of Salmon, with investing bones and facial arches removed. Op.O, opisthotic; Sp.O, sphenotic; L.Eth, lateral ethmoid; H.Tr, hypo-trabecular.

The structure of the facial arches, and the chief points in the development of the salmon's skull, will be considered in the next paper.

(*To be continued.*)

THE COMING TRANSIT OF VENUS*

III.

IN the previous articles various methods have been indicated by means of which we may discover the scale upon which the plan of the solar system is drawn. The last article concluded by illustrating the nature of the methods of employing a transit of Venus, as proposed by Halley. It will be noticed that this method can be utilised in the way there indicated only when Venus passes nearly across the diameter of the sun. Halley, in fact, founding his calculations upon erroneous data, was led to conclude that this would be the case in 1761. In this he erred, and another slight but important mistake having been made in his calculations, it followed that at Hudson's Bay, his northern station, the transit was invisible.

The present article will be devoted to a description of the methods to be employed in the coming transit for determining the solar parallax. In subsequent articles the preparations which have actually been made for observing the transit of 1874 will be described; and the difficulties encountered in this kind of observation enumerated.

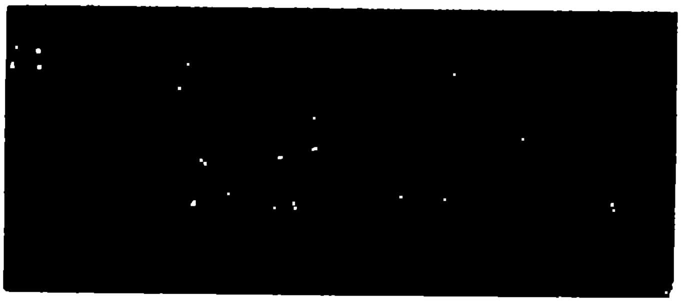


FIG. 11

Let the reader now examine Fig. 11 and pay particular attention to the description of it, and he will thus be enabled better to understand what follows. The earth, Venus, and the sun are here represented in their relative positions; and lines are drawn to show the directions in which two observers at opposite sides of the earth will see Venus upon the solar disc. It follows from this that an observer on the southern portion of the earth will see Venus trace a path D E F upon the sun's disc farther north than the path A B C which a northern observer on the earth sees it trace. Now Venus will be three times as far from the sun as from the earth on that date. From this it follows that the distance between the two lines A B C and D E F will be three times as great as the distance N S. But the distance N S upon the earth can be easily found out. Suppose it to be 6,000 miles. In that case the distance between A B C and D E F is known to be 18,000 miles. But it needs no demonstration to convince us that if we have a distance of 18,000 miles measured out for us upon the sun's surface we can determine the distance of the sun from the earth.

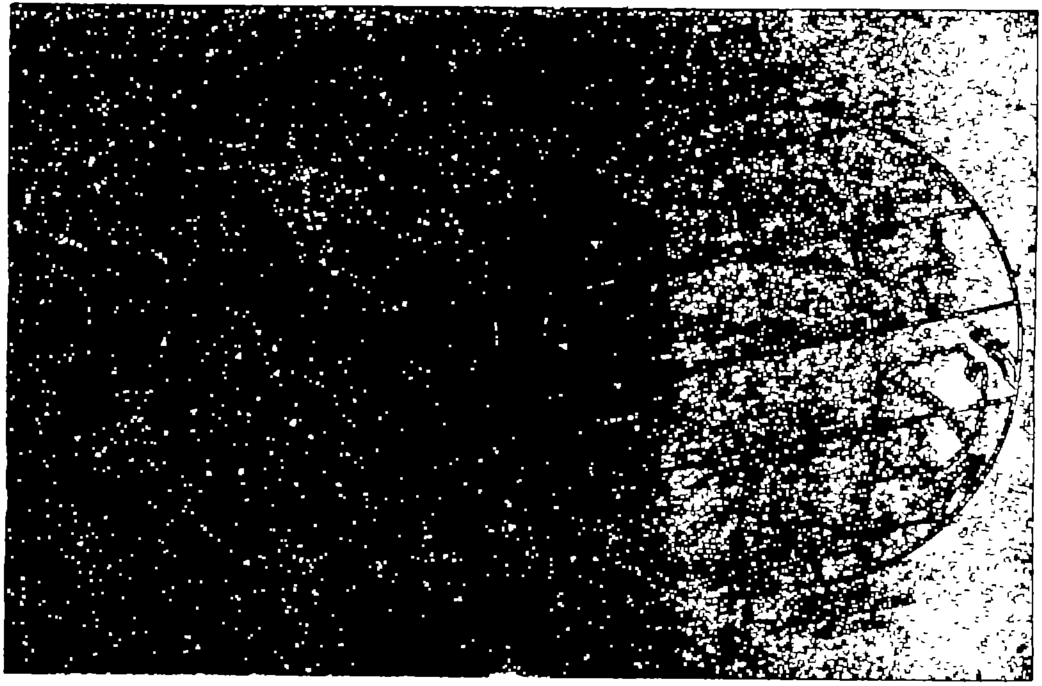


FIG. 12.

Now the apparent distance between the two lines A B C and D E F is the least observed distances between Venus' centre and the sun's during the transit. *If then, we can measure accurately the least distance between the centres of Venus and the sun, at two stations suitably chosen, we can determine the sun's distance.*

There are three methods by means of which this may be effected; the photographic method, the heliometric method, and the method of durations. We shall consider these in order.

---

* Continued from vol. ix. p. 439

I. *The Photographic Method.*—It is easy to see that by continuing during the transit to take photographs of the sun, in which Venus will be represented as a black spot, these photographs may be so combined as to indicate definitely the apparent path of Venus as seen at these two stations. This method is looked forward to with much interest, because it is the first time that photography has been extensively employed in delicate astronomical measurements. It is not generally known how extremely accurate a means of observation photography is. We owe much to Mr. De la Rue, whose success in the application of photography to astronomy has been unequalled, for having given us a most clear account of what has been done in this way.* The method has been employed in America to measure the distances between double stars. The double star is photographed and the distance is afterwards measured as accurately as possible. Prof. Bond finds that the probable error of such a measurement is 0″·072 or ⅓ of the probable error of a similar measure made with a filar micrometer as estimated by Struve. Photographic pictures of the sun were for many years daily taken at Kew, and it was found that an extremely accurate measure of the sun's diameter could thus be made. If the lens of a common telescope were used to produce an image of the sun upon the sensitive plate the picture would be too small for accurate measurement. Hence a special instrument called a photoheliograph must be devised to give an enlarged picture upon the sensitive plate. Two perfectly distinct kinds of instruments are to be used for this purpose, the one English, the other American. Mr. Dallmeyer has, under the superintendence of Mr. De la Rue, constructed photoheliographs for the English and Russian expeditions. In these instruments the image of the sun produced in the focus of an ordinary telescope is enlarged by a special arrangement so as to give a picture of the sun about four inches in diameter. This instrument, based upon the principle of the Kew photoheliograph, is very perfect in its results and convenient in actual practice. It is mounted equatorially so as to follow the motion of the sun. The sensitive plate, which is prepared in an adjoining room, can be readily inserted and exposed. The intensity of direct solar light is so great that special means are necessary to give a short enough exposure. Before a photograph is taken a sliding shutter in the interior of the instrument cuts off all light from the sensitive plate. This shutter is held in its place by a cotton thread. So soon as this thread is cut, a strong spring draws down the shutter, in which is a slit about ⅒th of an inch wide. The time taken by this slit to pass over any part of the sun's image is the whole interval required for an exposure.

The other method of obtaining a large picture of the sun is by employing a lens of great focal length. This method was originally proposed by Mr. Rutherford, of New York, and will be employed by the Americans, and also by Lord Lindsay in his observations at the Mauritius. The focal length of the lens is forty feet. But a telescope of such dimensions could not be conveniently mounted in the ordinary way. To overcome this, a siderostat similar to the one originally constructed by M. Foucault for the Observatory of Paris is employed. This instrument consists of a plane mirror so mounted as to send the sun's rays always in the same horizontal direction. In the path of these rays, and close to the siderostat the lens is placed, and at a distance of forty feet an image of the sun about four inches in diameter is produced. At this place a window is arranged in the photographer's hut, and by means of this arrangement the photographer need never leave his dark room. After preparing a plate he places it in position at the window; when exposure has been made he may remove the plate and develop it.

Considerable advantage is likely to accrue to the employment of dry plates, which will diminish the labour of the photographer. Researches upon this matter have been undertaken by Prof. Vögel, in Holstein, Col. Smysloff, at Wilna, and by Capt. Abney, at Chatham. The employment of a dry process prevents all danger from the shrinking of the collodion-film. Herr Paschen* and Mr. De la Rue have made experiments upon this point. The latter gentleman finds that all shrinkages take place in the thickness of the film, so that the measurements would not be affected by it. But the more convenient dry-plate process is undoubtedly safer. Judging from the data furnished by Mr. De la Rue, this photographic method will give results of the utmost value.

II. *The Heliometric Method.*—The exact measurement of the distances of the edges of Venus from opposite edges of the sun would enable us easily to determine what is required, viz. the least distance between the centres of the sun and planet. But the ordinary astronomical means are useless in measurements of this magnitude. To obviate this, a special instrument, called a heliometer, will be employed by the Germans and Russians, and by Lord Lindsay. This instrument was originally invented for measuring the diameter of the sun. The object-glass of a common telescope is divided, so as to form two semicircles. A screw adjustment allows us to slip one-half of the lens past the other one along their line of junction; a fine scale measures this displacement. When the two halves of this object glass are relatively displaced, two images of the sun are seen overlapping. The distance between the two images is proportional to the relative displacement of the two halves of the object-glass. This instrument has been brought to a state of great perfection by Mr. Repshold, of Hamburg. It is a very troublesome instrument to manipulate, and the corrections due to the influence of temperature are extremely difficult to apply. Yet with great care there is little doubt that very accurate measurements can be made. The nature of the measurements required to obtain the distance between the centres of Venus and the sun will readily be understood. The method has been most ably discussed by Lord Lindsay and Mr. Gill in the Monthly Notices of the R.A.S., November 1872.* At the same time it is difficult to conceive that this direct method will give results of equal value with the methods hereafter described. In fact, an opposition of Mars would be expected to give equally good results; for the distance of Mars from a fixed star can be more accurately observed with a micrometer than the distance between the centres of Venus and the sun; and a larger number of observations could be made.

III. *The Method of Duration.*—The third method of determining the least distance between the centres of the sun and Venus is less direct than either of the preceding methods; but it has stood the test of a previous trial, and we cannot say but that it will be more satisfactory than the other methods in the coming transit. The method of duration closely resembles the method originally proposed by Halley. The duration of the transit, as viewed from two distinct stations, is accurately determined. But the difference in this duration is affected by choosing stations upon a different system. Nevertheless this method is frequently called Halley's method. His method consisted in choosing two stations, so that during the transit the one should be moving eastward and the other westward. It is further essential for success that Venus should pass nearly along the diameter of the sun. In the method employed last century, the two stations were chosen—the one far north, and the other far south. On referring to Fig. 11 it will be seen that in each case Venus appears to pass along a chord of the sun. But in the one case this chord is farther from the sun's centre, and consequently shorter than the other. The duration of the transit, so far as this effect is concerned, is directly proportional to the length of the chord traced out by Venus. Thus from observation we obtain the lengths of these chords; and by geometry we can deduce the least distance between the centres of the sun and Venus at each of the two stations, and hence we can determine the sun's parallax. Fig. 12 illustrates this point very clearly. The duration is determined by two distinct observations made at each station, the internal contact at ingress and the internal contact at egress. The time of an internal contact is the time at which Venus appears to be just wholly within the sun's disc. These two times must be accurately determined; they will be separated by an interval of nearly four hours. Fig. 12 represents the illuminated hemispheres of the globe at the time of ingress and at the time of egress respectively in 1874. At either of these epochs the sun will be visible from every place marked on the corresponding map. The sun will be vertical at the place occupying the centre of the map; at all stations near the edges of the map the sun will at that time be near the horizon. The point from which the phenomenon will be first observed is there indicated, and likewise the point at which it is last seen. Straight lines are drawn across each map, and the hours marked upon them indicate the time at which the phenomenon will be seen.

---

* Address to the Mathematical and Physical Section of the British Association, Brighton, 1872.

* *Astronomische Nachrichten*, 1872, lxxix. 161.

Fig. 13, taken from Lockyer's "Popular Astronomy," shows the same facts for the transit of 1882.

Take now the case of two particular stations. At some point on the east coast of China the ingress is accelerated by 6 minutes, but at the same point the egress is retarded 7 minutes; consequently the duration of the transit is lengthened 13 minutes. Again, at Kerguelen's Island the ingress is retarded 10 minutes, while the egress is accelerated 5 minutes. Here then the duration of the transit is shortened 15 minutes. The difference in duration as observed from these two stations will therefore be about 28 minutes. These maps have no pretension to great accuracy. They are calculated upon a certain assumption as to the value of the solar parallax which is probably not far from the truth.

In 1761 considerable preparations were made for observing the transit of Venus in this manner. The English were represented by Messrs. Mason and Dixon at the Cape of Good Hope, and the French by the celebrated Pingré at the island of Rodriguez. A host of observers watched the phenomenon from northern regions. Unfortunately at scarcely a single station was the transit seen completely. Hence the method of durations was inapplicable, and another, originally proposed by De l'Isle,* came into use. This takes advantage of the fact that the ingress will take place later when seen from some parts of the earth than from other parts, as explained above; so with the egress of the planet from the sun's disc. Hence, if the absolute time of contact of Venus with the sun's edge at ingress or at egress be observed at two places suitably chosen, the difference in time will be a measure of Venus's parallax.

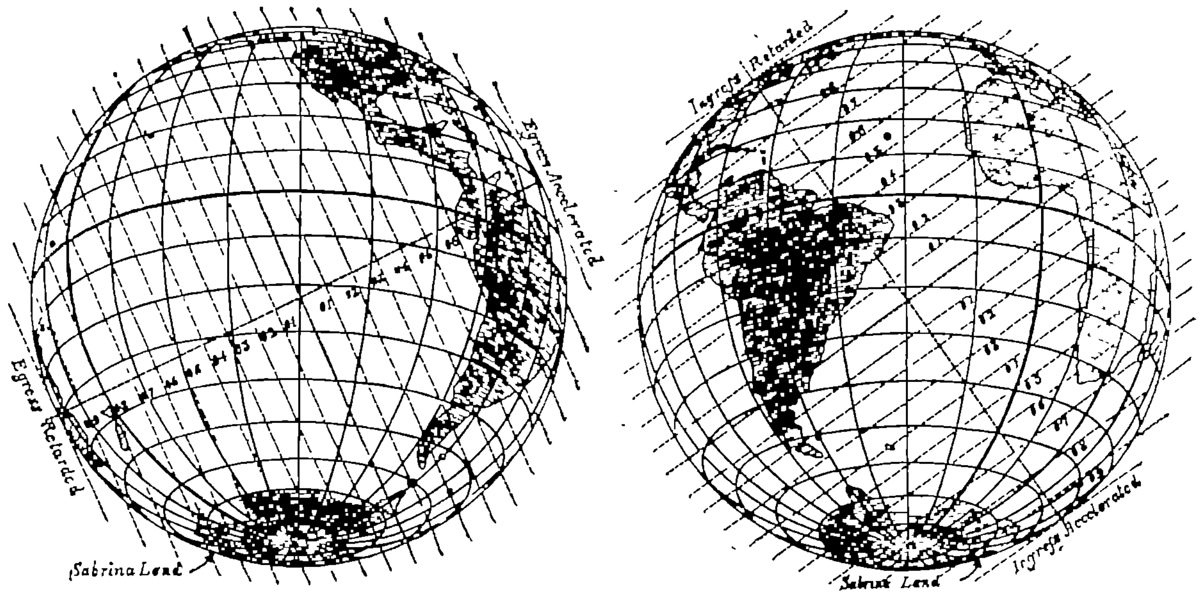


Fig 13

The method of De l'Isle will perhaps be better understood by looking upon the orbit of Venus as a vast protractor for measuring small angles. Venus passes relatively to the earth round the sun, that is through 360° in 584 days. From this it follows that she passes over 1''·5 in one minute of time. Now conceive two straight lines to be drawn from the sun's edge, the one to the Sandwich Islands, where the ingress is most accelerated, and the other to Kerguelen's Island, where it is most retarded. Venus passes across these two lines like the radial arm of a protractor. The observed difference in the time of observing the phenomenon at these two stations will be about 21 minutes. Of this about 11 minutes is due to the fact that the Sandwich Islands are north of Kerguelen's Island, as before explained; the remaining 10 minutes or so will be a measure of the angle between the two lines drawn from the sun's edge to the two stations. Since Venus passes over 1''·5 in 1 minute, 10 minutes gives us 15'' for the effect of parallax looked at in this light.

It is a comparatively easy matter to set one's clock accurately to local time by astronomical observations. But it is a matter of considerable difficulty for an observer in Kerguelen's Island to set his clock accurately to the local time of the Sandwich Islands, or *vice versâ*. Consequently there will be some difficulty in determining the absolute difference of time of contact as observed at these two stations. The difficulty simply consists in determining the longitude accurately. This is a matter involving a long series of astronomical observations even now; still more so in 1761. Such observations were then wanting. Hence the application of this method was not successful, and results of that transit were unsatisfactory.

---

* Histoire de l'Acad. des Sciences, p. 111.

Not daunted by the comparative failure of that attempt, the astronomers of last century made vigorous efforts to make the transit of 1761 successful. The transit of 1761 was utilised in so far as it pointed out the difficulties in this kind of observation and gave them an approximate value of the sun's parallax to help them in choosing the most advantageous stations from which to observe the next transit.

Halley had no conception, when he proposed this kind of observation, of the difficulties attending it. The difficulty chiefly consists in determining accurately the exact instant when the contact seems to take place. The values which have been deduced from the observations of last century, and especially of the year 1761, have varied considerably according to the mode of reducing the observations. Thus in 1761 Lalande[*] found, from the observations of Pingré, 9″·4 for the solar parallax, while Maskelyne found from the work of Mason and Dixon 8″·6; Short[†] made it 8″·65; Wargentin, 8″·1 to 8″·3. Encke[‡] showed that the differences were partly due to an error in the longitude of Rodriguez. This question will be capable of further discussion after this year, as Rodriguez is one of the stations chosen by the English from which to observe the coming transit.

Since the observers are likely to differ considerably in the manner in which they observe the contact, and since it is difficult for us to be sure that all observers have really actually noted the same phenomenon, photography is once more brought to our aid. Some time ago M. Janssen proposed a method for determining by the aid of photography the exact instant of contact. The value of his method was immediately recognised, and steps have been taken to utilise it. The method consists essentially in exposing different parts of a prepared photographic plate in succession to the sun's light, so as to photograph that portion of the sun's limb at which the planet is visible. By the aid of no very complicated mechanism a circular plate is so arranged that sixty different portions of its surface near the circumference are successively brought into position, and exposed to the action of the sun's rays. The plate completes a revolution once in a minute, so that sixty photographs are taken at intervals of one second. A person who is observing with a telescope can easily give a signal to commence these photographic operations at the proper time. Thus one of the photographs will be sure to give us an indication of the time of true contact. Furthermore each one of the photographs taken at one station can be compared with a corresponding one taken at another station, so as to give us a means of deducing the sun's parallax. The advantages of this method are enormous. The uncertainty which exists with respect to eye observations is in a great measure due to fluctuations arising from tremors in the instruments, and variations in the density of the intervening air. In the photographic method, means have been taken to avoid these tremors as far as possible; and the instantaneous manner in which the photographs are taken will reduce these uncertainties to a minimum.

Various suggestions have been made as to the possibility of observing the exact time of the external contact by using a spectroscope in a beautiful manner originally executed by Mr. Lockyer and M. Janssen for observing the solar protuberances. Father Secchi has, in a very able memoir, pointed out a way by means of which this can be done; M. Zollner has likewise pointed out the advantages of this method.

The observation of external contact is doubtless very useful as supplementary to the internal contact. The chief difficulty consists in the uncertainty of fixing the telescope in the proper position, so as catch the exact point of the sun's limb. This difficulty would certainly be to a large extent obviated by the employment of the ingenious adjustible ring-slit devised by Mr. Lockyer. This device has, we believe, been fully tested, with satisfactory results. It is much to be regretted that more observations to test its utility have not been made; as on this account it is not likely to be employed in the coming transit.

We have now completed the geometrical examination of the nature of the observations on the transit of Venus, by means of which the sun's parallax will be deduced. The complete examination of the question, including analytical methods, cannot be here dwelt upon. Anyone who is interested in this should consult the valuable work "Les passages de Vénus sur le disque Solaire," by M. Edmond du Bois, lately published, in which the theoretical part of the question is very fully investigated.

RECAPITULATION.—Before leaving the technical view of the matter it will be well to recapitulate what has hitherto been stated.

1. We know the *relative dimensions* of the solar system accurately; but we do not know the *scale*.

2. The determination of the distance of the earth from the sun or from any of the planets, at a fixed date, fixes the scale.

3. This may be determined (1) by the aid of a transit of Venus; (2) by an opposition of Mars; (3) by a knowledge of the velocity of light combined with observations of eclipses of Jupiter's satellites; (4) by the velocity of light and the constant of aberration; (5) by the calculated effects of the sun's disturbance upon the lunar motions.

4. A transit of Venus may be utilised:—
   - (a) By the determination of times of contact at different stations, combined with a knowledge of the longitudes of these stations.
   - (β) By determining the least distance between the centres of the sun and Venus during the transit, observed from different stations.

5. This last determination may be made by either of these methods:—
   - (1) The Photographic Method.
   - (2) The Heliometric Method.
   - (3) The Method of Durations.

GEORGE FORBES

---

[*] Phil Trans., vol lii, p. 647.

[†] *Ibid.*, p 648.

[‡] Zach. Corresp. ii., 1810, p. 367.

NOTES

THE Board of Trinity College, Dublin, have appointed R. Ball, LL.D., F.R.S., to be Royal Astronomer of Ireland, on the foundation of Dr. Andrews. The announcement of this appointment will be received with every satisfaction, as Dr. Ball has already, while acting as assistant to Lord Rosse, distinguished himself as a practical observer. We feel sure he will not forget to profit, or omit to allow astronomical science to profit too, by the excellently appointed observatory at his command. This vacates the chair of Applied Mathematics in the Royal College of Science, Dublin.

AT a meeting of the donors of the Yorkshire College of Science (see NATURE, vol. ix. p. 157) held at Leeds last Thursday, the constitution of the College was agreed upon, and a board of governors elected. The sum required to establish a College of Science in any way worthy of Yorkshire would be 60,000*l*., of which only about 25,000*l*. has as yet been collected. With this sum, however, we are glad to see that it has been resolved to make a start, and we have no doubt that when the practical benefits of the institution become evident there will be little difficulty from lack of funds. We trust with Lord F. Cavendish that, ere long, the institution just organised will occupy in Yorkshire a position similar to that occupied by Owens College in Lancashire. Several speakers referred to the fact that in the practical applications of Science Britain is being distanced by Germany and other countries, and that the only means by which we can hope to compete with foreign rivals is the spread of scientific education. It is hoped that, before the close of the year, a staff of thoroughly competent professors will be giving their lectures in Leeds.

THE annual general meeting of the Iron and Steel Institute commenced yesterday in the rooms of the Institution of Civil Engineers, under the presidency of Mr. Lowthian Bell, F.R.S.

THE Port Louis *Overland Commercial Gazette* (Mauritius) of April 4 contains the report of a violent cyclone which embraced Mauritius in its sweep on March 27 and 28. Indications of the approaching hurricane were observed on the 22nd in a falling barometer and a gradually rising wind, which increased until it reached its height on the two days mentioned. Its greatest force was 11 (Beaufort scale), and the barometer sank as low as 28 566 at 3.30 P.M. on the 28th. The mischief done to the growing canes was not nearly so great as was anticipated, though in several places considerable damage has been sustained. Shops in many parts of Port Louis were closed, and on the 27th two of the local newspapers did not appear. The town itself presented a very sad appearance after the storm was over, the roofs and *débris* of fallen houses and dependencies, and broken trees innumerable, partially obstructing all but the main streets. The cellars of a great many houses were inundated, and a certain amount of valuable goods has been destroyed. There were very few houses in the upper part of the town but were more or less injured; verandahs, kitchens, stables, gates, palings, and such like light constructions having been blown down by the hundreds. The museum at the Royal College was unroofed, but the curiosities it contained have received no damage. The suburbs of the town were devastated, most of the smaller wooden houses, huts, and camps having disappeared. As was unfortunately to be expected, many lives were lost.

THE Royal Academy of Belgium proposes the following subjects for prizes to be awarded in 1875:—(1) To examine and discuss on the basis of new experiments, the perturbing causes which influence the determination of the electromotive force and the internal resistance of an element of the electric pile: to estimate in numbers these two quantities for some of the principal piles. (2) To show the present state of our knowledge on the relations of heat to the development of phanerogamous plants, particularly in respect to the periodic phenomena of vegetation; and, in this connection, to discuss the value of dynamical influence and of solar heat upon the evolution of plants. (3) To make experiments on the development of the *Tunicata*. (4) To show by new researches the composition and relations of albumenoid substances. (5) To describe the coal system of the basin of Liége. Each prize consists of a gold medal, of the value of 1,000 francs for subjects (4) and (5), and of 600 francs for the first three subjects. The papers may be written in Latin, French, or German, and must be sent to the Secretary of the Academy before August 1, 1875.

ON Saturday last the extensive works for the manufacture of telegraphic cables, belonging to the Messrs. Siemens, at Charlton, were thrown open to a select party of visitors, among whom were Lord Bury, Lord Rosse, Baron de Reuter, Professors Abel, Maxwell, Odling, Tyndall, and Williamson, Sir Charles Wheatstone, Mr. C. F. Varley, and Messrs. Culley and Preece, of the Engineering Department of the Postal Telegraph Service. These works comprise nearly every branch of telegraphic manufacture, but public interest becomes mainly centred on that part of the operations connected with the manufacture of submarine cables. The *Faraday*—the new ship to be employed in laying the direct United States cable, and the property of Messrs. Siemens—is undoubtedly a novelty in cable ships. It is an iron ship of 5,000 tons register, but equal to carrying a gross burden of nearly 6,500 tons. She is 360 ft. long, 37 ft. deep, and has a breadth of beam of 52 ft. Her capacity for cable storage is immense, consisting of three tanks, two of which are 45 ft. in diameter, the other 37 ft. in diameter, and each 27 ft. deep. Five thousand tons of cable can be thus stowed away, and it is calculated that this will be equal to about 1,500 miles of the cable, which is now being taken on board.

MR. HENRY WILLETT, F.G.S., has published another letter in reference to the Sub-Wealden Exploration. He says:—"We have now run through about 400 ft. of Kimmeridge clay. Nearly every inch contains numerous fossil shells in various stages of growth, each of which has been born, has grown, and died. Our little 2-inch column has contained several thousands. There is no reason to doubt that this bed of clay extends uninterruptedly beneath Brighton, Chichester, Southampton, Sussex, Hampshire, and Dorsetshire, to Kimmeridge on the west, and beneath Hastings and the English Channel to the Boulonnais district in France, and that throughout the whole of this vast area, the same conditions of birth, life, and death have existed."

A TELEGRAM from Aden to Vienna announces the death of Richard Brenner, the celebrated African traveller, which took place at Zanzibar on March 22.

IN a pamphlet on "Agricultural Schools and Experimental Farms" (Blackwood), Mr. David Milne Home points out very forcibly how immensely far behind all the rest of the world is this country, so far as the teaching and practice of scientific agriculture is concerned. For many years, in Germany and Austria, institutions supported by the state have been at work, not only for giving those who intend to follow agriculture as a vocation a thorough education in the scientific principles of that art, but also for scientific education in the principles and materiel of agriculture in all its branches. Other continental countries are following the example of Germany and Austria, and, more recently, numerous institutions of a similar kind, partly aided by Government, have been established on the best models in the United States. The consequence is that Britain is being out-distanced in a department which used to be deemed peculiarly British; and the only means by which she can regain and keep her place as an agricultural country is by getting Government to take the initiative in founding agricultural institutions similar to those of the countries we have named. "Every civilised country except Britain," Mr. Milne Home tells us, "has its Minister of Agriculture, to look after and promote its agricultural interests."

M. GAUTHIER VILLARS will publish very shortly the 10th volume of the "Annals of the Observatory." This is almost exclusively occupied with a paper by M. Leverrier On the Mutual Actions of Jupiter and Saturn; a paper by MM. Wolf and André, On the black drop, has been reprinted from *Memoirs* of the Academy, and annexed to it. Tome XI. contains a paper On a special theory of Jupiter and Saturn, and secular inequalities; it will also be published very shortly. Tome XII. is nearly all printed; it contains the tables of Jupiter, reduced from M. Leverrier's theory. All the numerical results were obtained at the Bureau de Calculs of the Observatory. The positions of Jupiter were taken from these for 1878 and 1879, and sent to Mr. Hind for publication in the *Nautical Almanac*. It will contain also a paper by M. Rayet, On Magnetical Observations, which have been taken at the Observatory during these last two centuries.

THE *Times* New South Wales Correspondent writes that an explanation of the fate of the lost Australian explorer Leichhardt has been offered, which, however, is considered very unsatisfactory. The Leichhardt expedition set out in 1844 and never returned. Andrew Hume, who was despatched by the Sydney Government in 1872, to recover some relics of the expedition has returned, and reports that he found Classen, Leichhardt's second in command, living with the blacks at the head of the waters of Stewart's Creek; Classen, Hume says, is detained by the blacks as a sort of wonder-man. Classen, according to Hume, states that Leichhardt's party mutinied at the head of Victoria River, and that after the struggle with their leader they left him when pushing on to the north-west coast. During this affair Classen was always seeking for water. When he returned, he says that Leichhardt was insensible, and died five days after the mutiny. The camp had been broken up and the horses taken away by the men. Hume says that he possessed himself of Leichhardt's quadrant and watch, and about seventy-five pages of the traveller's records. He also affirms that he saw the remains of the dead man concealed in a tree. The mutineers, he reports, were all killed at Ayer's Creek. Hume, it seems, has not shown to any one the relics he says he has recovered, and his story, as we have said, is generally discredited. Leichhardt's last letter is dated "Darling Downs, February 22, 1848."

IN a report on the trade of Tamsuy, China, we are told that the Camphor trees (*Cinnamomum camphora* F. Nees et Eberm.) are not found within the district marked on maps of Formosa as Chinese territory. They occur only within the country of the aborigines, or upon the immediate border. The manufacture of camphor necessitates the destruction of the trees, which are never replanted; as the country becomes denuded the aborigines recede, and the Chinese effect a corresponding encroachment. As a consequence, the border country is in a continuous state of disturbance, and fearful outrages are committed by both sides on every opportunity.

A PETITION signed by twenty-six Professors in the Universities of Scotland has been presented to the Prime Minister, calling his attention to the treatment of the ladies admitted to matriculate as students of medicine in the University of Edinburgh, and afterwards refused the right to graduate, and urging the Government to take the whole subject of the University education of women into consideration, with the view of devising a remedy for the present anomalies.

THE General Local Committee which has been formed in Belfast for the purpose of making arrangements for the ensuing meeting of the British Association is already busy at work, and 3,000*l.* is being raised for the purpose of giving a proper reception to the Association; of this amount upwards of 1,600*l.* has already been collected. It has been arranged to prepare a list of lodgings for members who might not be otherwise accommodated, and other details are being attended to with regard to excursions, &c. The business meetings of the Association will be held in the Queen's College.

MR. J. H. LEWIS of Liverpool proposes to issue twenty sets of British Rubi, if names of subscribers are to hand by June 1. Each set will contain examples of twenty forms. Each example will show two flowering shoots—in flower and in fruit—and two pieces of barren shoot—young and old. In gathering, avoidance will be given to hedgerow-clipped plants, and preference shown, in this fasciculus, to those that exhibit characters corresponding to Prof. Babington's species and varieties, as described in "British Rubi," 1869. Printed tickets will be given containing remarks on most of the forms by Prof. Babington, Rev. A. Bloxam, Mr. Baker, and Hon. J. L. Warren. If encouragement be given to this fasciculus, others will be issued having more regard to intermediate and dubious forms. The price will be 1*l.* per set.

DR. J. E. GRAY has expressed his opinion that so far as he can judge from the description and drawing of the whale taken off Otago Head, New Zealand, in October last, it is a specimen of *Neobalæna*, of which only the skull has been known before. He established the genus *Neobalæna* from drawings of a skull in the museum at Wellington, which had been found at the island of Kawan, and in the An. and Mag. of Nat. Hist., vol. vi. p. 156, he wrote, "the difference in skull makes us anxious to have a description of the entire animal and its skeleton, as the animal may prove to be the type of a new family of whales between the true whales and finners." This capture affords an opportunity for the first time of examining an entire skeleton, and a description is promised by Dr. Gray. The measurements taken by Prof. F. W. Hutton, of the Otago Museum, Dunedin, gave the length 16 ft. 2¼ in., girth at pectoral 10 ft., pectoral flipper 2 ft. 7 in. long, caudal flipper 1 ft. 6 in. Weight 27 cwt.

THE recently issued number of the *Bulletin* of the Geological Society of France contains an abstract of a paper On a Comparison of the Inferior Eocene of the Basins of Paris, Belgium, and England. The paper will appear in full in the fourth volume of the *Annales des Sciences Géologiques*. The correlation adopted is as follows:—

PARIS BASIN.	BELGIUM.	ENGLAND.
Sables à nummulites planulata	Panisélien	Lower Bagshot sands
Sables sans fossiles	Yprésien supérieur	
Gap	Argile d'Ypres	London clay
Gap	(?)	Oldhaven beds
Argile plastique	Landénien supérieur	Woolwich beds
Sables de Bracheux	Landénien inférieur	Thanet sands

In the same bulletin M. Pouech describes an incomplete humerus, a fragmentary maxilla, and a molar belonging to *Elephas primigenius*, found by him in the ravine of Vicaris, near Pamiers. He believes it to have been contemporaneous with the Troglodytes of Vezère, d'Aurignac, and Clermont. There is also a description by M. Gaudry of the anterior part of the head of *Anthracotherium* found at St. Menoux. A full-size drawing is given showing the teeth of the upper and lower jaws interlocking.

M. DE BILLY, who had been appointed president of the French Alpine Club, has been killed by a railway accident, even before his nomination was notified to him. M. Cezanne, an engineer of the Ponts et Chaussées, and one of the most promising members of the National Assembly, has been appointed to fill the vacancy created by the unexpected demise of the learned gentleman. M. Cezanne is one of the members for the department of Hautes-Alpes; he has written an admirable work on the "Degradation of Mountains by Waterfalls."

M. A. FOUQUÉ will deliver, at the College de France, a series of lectures on the volcanic emanations of Etna, Santorin, and Açores, where he has been sent by the French Academy to report upon these most interesting phenomena.

THE French Association for the Advancement of Science has voted to M. W. de Fonvielle a sum in order to encourage him to recommence his course of systematic balloon ascents. M. de Fonvielle intends to study the differential direction which it is possible to give to an aërostat in varying the altitude for taking advantage of several directions of winds. It is not known yet whether he will practise his method for travelling in Europe or in America.

THE eighth number of Mr. Hermann Strecker's work on the Lepidoptera has just been published by him at Reading, Pennsylvania, and upon a closely filled plate are to be found illustrations of eight species of butterflies, one of them but recently described as new by Mr. Strecker.

THE annual report of the Academy of Sciences of Philadelphia announces the final completion of the labour upon which Mr.

Tryon and his associates have been engaged for several years past, namely, the arranging, labelling, and mounting of a very extensive collection of shells belonging to the Academy. The total number by actual count is 14,161 species, in something less than 100,000 specimens. The collection is stated to be one of the finest extant.

THE Cambridge Natural Science Club held six meetings during the past Lent term; there are now fourteen members Undergraduates and Bachelors, nearly all of whom were in residence and attended regularly, often bringing friends as visitors. The following were the subjects discussed:—Climbing Plants, introduced by Mr. Stone, St. Peters; the Functions of the Cerebral Hemispheres, introduced by Mr. Bridge, Trinity; Precious Stones, a paper by Mr. Alfred Buxton, Trinity; Zoological Colonies, a paper by Mr. A. J. Jukes Brown, St. John's; Metamorphosis, a paper by Mr. A. M. Marshall, St. John's; Allotropism, a paper by Mr. C. P. Clough, St. John's. The meetings commence again on Saturday the 25th inst., and will be continued during the present term, and through the Long Vacation, should a sufficient number of members be in residence.

AT the last monthly meeting of the Manchester Geological Society, Mr. Plant exhibited a large collection of remains of *Bos priscus* and *Rangifer*, obtained from Castleton, Derbyshire. The largest bones were portions of the skull, with the horn-cones attached, femora, and vertebræ, all much incrusted.

THE additions to the Zoological Society's Gardens during the last week include a Common Crowned Pigeon (*Goura coronata*), hatched in the Gardens; a Prince Alfred's Deer (*Cervus alfredi*) and a Vulpine Phalanger (*Phalangista vulpina*), born in the Gardens; and a Great Kangaroo (*Macropus giganteus*) from Australia, deposited.

THE METEOROLOGICAL CONGRESS AT VIENNA *

THE Meteorological Congress, which held its meetings in Vienna from the 2nd to the 16th of September last, had its origin in a wide-spread conviction that since meteorology can be prosecuted with success only when it is treated internationally, uniformity of procedure among different nations is indispensable; and it was to bring about this uniformity that the Congress was convened. A preliminary Conference was held at Leipsig in August 1872, for the purpose of preparing the programme for the Congress. The Austrian Government issued invitations to other Governments to send delegates to the Congress. To these invitations every European country, except France, responded, and the United States and China were also represented.

The questions which were discussed, and the names of the delegates, have already appeared in NATURE.† The following is the deliverance of the Congress on these questions:—

1. A decision regarding the best mercurial barometer for stations of the second order was postponed to a future Congress. Aneroids should not be employed at stations where there is no other barometer, but they may be used as interpolation instruments alongside the barometer.

2. It was considered impossible to lay down fixed rules for general adoption in the protection of thermometers, on the ground that regard must be had to local conditions, and that the mode of exposure which is most to be recommended, in a space which is open and accessible to all winds, and at a height of 4½ to 6 ft., cannot be used everywhere.

3. Casella's minimum, and Hermann and Pfister's metallic thermometer, since they are found to become frequently deranged, cannot be recommended for stations at which they cannot be kept in proper order and their errors ascertained. For minimum thermometers, amyl-alcohol is to be preferred to ordinary alcohol, as being less liable to distillation. It is recommended that maximum and minimum thermometers be read at the last observation of the evening, and entered on the day on which they are taken.

4. Reference having been made to the experiments on radiation by Symons, Stow, and Soret, further experiments were recommended to be undertaken by physicists, so that the subject might be brought into the sphere of the regular observations.

5. Lamont's method of observing earth temperatures, which consists of a wooden tube, to the bottom of which the thermometer is let down, and up which it is drawn in order to be read, was recommended as giving more trustworthy results than thermometers with long tubes fixed in the ground. New experiments should be made in different countries, in order to decide the question at what depths observations should be taken.

6. The use of the wet- and dry-bulb hygrometer is in the meantime recommended, and the attention of physicists is drawn to the invention of some new apparatus by which the humidity of the air may be more accurately determined. Hair hygrometers can only be used with safety where care is taken to have their indications compared with those of the wet- and dry-bulb hygrometer, so as to determine their corrections, especially near the point of saturation, where the readings are often too low.

7. It was agreed to introduce the English designations of the directions of the wind:—N. = North, E. = East, S. = South, and W. = West, and to give only sixteen directions of the wind; and in the case of intermediate directions being observed, it is proposed to count them alternately to the one or the other. Lambert's formula is not to be recommended in deducing the mean direction of the wind; but, on the other hand, the frequency and mean force of the winds which correspond to the different directions should be given in numbers. In the distribution in the windrose, those winds whose velocity is less than ½ metre per second, or 2¼ English miles per hour, are not to be regarded, but counted as calms. The direction of the cloud-drift should be observed and noted.

8. No general scale for the estimation of wind-force is yet recommended, but it is desirable that a gradual advance be made towards giving the velocity of the wind in metres per second.

9. Wild's apparatus for measuring the force of the wind, already in use in Switzerland, Baden, and Russia, was recommended for introduction at stations of the second order. The velocity of the wind obtained by anemometers should be expressed in metres per second, and tables should be prepared for the mutual conversion of metres per second, kilometres per hour, and English miles per hour.

10. The best form for the receiver of the rain-gauge is a circular one with the area of one-tenth of a square metre, that is, having a diameter of about 14 in. The receiver of the rain-gauge should be placed at a height of not less than 1, and better, of 1½ metres above the ground, or at a height of from 3 to 4½ ft. In the published results the height above the ground should be stated. Where it can be done, the measurement of the rainfall should be at the end of the fall; in other cases the first observing hour of the day is recommended, in which case the amount is to be put down to the previous day. It is recommended that the duration of the fall be stated in hours.

11. It was agreed to introduce symbols for the character of the precipitation in the "Remarks" column, and to give in the monthly *résumé* the sum of the days of rain and snow separately; to have two columns, one for the quantity fallen, and one for the depth of the unmelted snow; and to give, in the yearly *résumé*, the maximum fall in twenty-four hours for each month. It was further recommended to state the number of days when the fall is less than 0·04 in. and 0·01 in.

12. Hail is defined to be as a precipitation of frozen water, in which the stones attain such a size that they may be expected to do damage to agricultural products.

13. (*a*) In order to obtain data regarding thunderstorms which admit better of comparison, it is recommended only to count the days of thunderstorms, but this is not intended to prevent individual observers from inserting in the column of "remarks," in addition, the number of the storms, the time of their commencement, their duration, direction of motion, &c.

(*b*) As days of thunderstorm, only those are to be noted on which both lightning and thunder have been observed. If only lightning without thunder has been noticed, the entry for the day should be sheet lightning.

14. As regards evaporation, the evaporating dish should not be less than seven inches in diameter, and it is indispensable that it be absolutely identical as regards diameter and depth at

---

* "Report of the Proceedings of the Meteorological Congress at Vienna." Protocols and Appendices. Translated from the Official Report Published by the authority of the Meteorological Committee. London, 1874.

† NATURE, vol. viii. p. 468.

all stations, if comparability is aimed at. The level of the water in the dish must remain constant, for the obvious reason that the evaporation is less the deeper the surface of the water stands under the edge of the vessel. Provision must be made for reading off the quantity evaporated with accuracy. The measurement of evaporation by means of floating apparatus on large surfaces of water should be introduced wherever possible.

15. (*a*) The degree of cloudiness is to be given by the figures 0—10, in which 0 represents a sky quite free from cloud, and 10 an entirely overcast sky. These figures refer only to the extension and not to the thickness of the cloud, the latter being indicated by accompanying expressions, such as "slight," "great," &c.

(*b*) Arbitrary symbols representing rain, snow, fog, &c., were adopted.

16. It was resolved that the institution of observations on atmospheric electricity be recommended only for head observatories. As regards ozone, the existing methods of determining its amount in the atmosphere are insufficient, and the Congress therefore recommended investigations for the discovery of better methods.

17. It was agreed that for observations as well as for publications, the use of the same units of measure is desirable; that among all existing systems of measure the metric has the best prospect of universal adoption; that it is most desirable, if it be not possible to introduce uniform measures at present, to use henceforth only metric and English measures (with Celsius and Fahrenheit scales), and that all action is to be supported which tends to the introduction of the uniform metric system. It was also agreed that the results of observations, or the means, should be published in the metric scale as well as in the original scales.

18. The hours of observation should be chosen which give a close approximation to the true mean temperature of the day. The following are the suitable combinations:—

h.	h	h.	h.	h.	h.		h.	h.
6	2	1	8	2	8	with min. temp.	8	8
7	2	1	9	3	9		9	9
7	1	9	10	4	10		10	10
7	2	9						

Observations should be set on foot at a number of normal stations, especially in Turkey, East Indies, Australia, Southern States, and Brazil, in order to ascertain the corrections for the most important meteorological elements, such as temperature, pressure, and humidity.

19. As units of time should be chosen (1) the mean solar day of the place of observation, reckoned from midnight to midnight; (2) the civil year; (3) the civil months everywhere, the calculation of the monthly means being simply arithmetical; and (4) Dove's 5-day means (73 in the year) for a selected number of stations of each country. It is proposed to count the first 12 hours of the day, from 1 to 12, as forenoon; and the following 12 hours, from 1 to 12, as afternoon; thus counting 12 o'clock midnight as the end of the day, and 12 o'clock noon as the close of the forenoon.

20. It is resolved to choose, as the periods for calculation of normal values, intervals of five years to be called *Lustra*, so that the next Lustrum will begin with January 1, 1876; and that as regards the more important data, old observations should be calculated in accordance with this proposal.

21. The existence of a system of weather telegraphy is, for all countries, considered to be a necessity; in addition to the direction and force of the wind, the barometric gradients at the time of observation should also be added. For purposes of storm warnings, the reduction of the barometer readings to mean sea-level for places not above 1,000 feet in height is admissible. For greater heights, the gradients are to be referred to the mean normal heights of the barometer at the stations. The relations of temperature, moisture, rain, cloud, and state of the sea and tides to storms, are recommended for investigation. As regards storm warnings, each director should give his opinion on the probable course of atmospheric disturbances which are expected, or have already commenced, not as prophecies, but as *probabilities*. Only wind-force of 8, and upwards, of Beaufort's scale should be announced.

22. As regards maritime meteorology, it is desirable that each country should, if possible, collect all its meteorological observations at one place, and that the Institute for Maritime Meteorology should be established as near as possible to the sea, and that this institute might best be placed under the general management of the chief institute of the country. The convening of a maritime meteorological conference was declared to be desirable, and the preparation for this conference is entrusted to the permanent committee appointed by the Congress.

23. It is necessary that in every country, at least one but in case of necessity several central institutions should be established for the management, collection, and publication of meteorological observations.

24. The verification of all instruments supplied to meteorological stations, and the inspection of stations yearly, but at least once in the course of every five years, is necessary. With regard to instrumental errors detected on verification, or inspection, corrected results only should be published. It is intended that the Permanent Committee prepare, in conjunction with the other members of Congress, instructions for the institution and discussion of meteorological observations.

25. As regards standard barometers and thermometers, each central office is recommended to adopt a real standard barometer, *i.e.* an instrument which allows of the determination of atmospheric pressure according to its definition in absolute measure, and to prepare a standard thermometer on scientific principles.

26. The publication of observations at stations of the first order should be entirely separated from those of stations of the second order. It is handed over to the Permanent Committee to prepare, in conjunction with members of Congress, a form of publication suited for international purposes.

27. It is desirable to organise, on the model of the Smithsonian Institution at Washington and the Central Bureau at Haarlem, a similar office for the exchange of publications in every country.

28. A Permanent Committee of seven, with the right of increasing their number to nine, was appointed, with Dr. Buys Ballot as president. The duty of this committee is to care for the carrying out of the decision of the Congress, and arrange for convening a future Congress; and it shall place the delegates of the Congress in cognisance with its action and proceedings.

For the extension of meteorological knowledge it was recommended that stations provided with self-registering instruments be established on high mountain-tops; that experiments on the possibility of continuous meteorological observations with captive balloons be instituted; that stations be established in the North Polar regions, and also in the high southern latitudes; on the north coast of Africa; that the organisation of the stations in Turkey be made more complete, especially the Central Observatory at Constantinople, and that the meteorological station at Athens be maintained.

29. The establishment of an International Institution for the Advancement of Meteorology was declared to be really useful and desirable, and it was remitted to the Permanent Committee to prepare a detailed scheme for this purpose for the consideration of a future Meteorological Congress.

(*To be continued.*)

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 1, 1874.—In this number M. Holz communicates an account of experiments on bar-magnetism which he made in Prof. Helmholz's laboratory. They had reference to the effect produced on magnetic moment of bars, when these were subjected to the corrosive action of dilute muriatic acid for twenty-four hours. He finds (among other things) that the amount of magnetic moment of a steel bar, with regard to quality, depends on the structure of the iron, and the carburet of iron (*Karboneisen*) united with it; that it increases per unit of weight, through abstraction of magnetised iron, and decreases through abstraction of magnetised carburet of iron; also, that particles of carburet of iron remaining after solution of the iron are magnetisable, and receive permanent magnetism.—M. Lehnebach gives a determination of the emissive power of dark bodies, by the ice-calorimetric method. The principle is briefly this: Suppose a thin glass sphere filled with ice, and placed within a larger sphere, whose temperature is above 0°, and constant; also that the former has an arrangement for showing the amount of ice melted in a given time, and a vacuum can be made within the spheres; then the increase of heat received by the inner globe may be measured calorimetrically. The apparatus is said to prove very serviceable for measuring emissive power.—M. Braun investigates some points connected with elastic vibrations, the amplitudes of which are not infinitely small; and M. Meyer studies the theory of elastic effects.—A method of graphic representation of absorption-spectra is described by M. Vierordt, and the curves are given for some ten different substances. The curves are very regular and characteristic, and he considers that with those spectra, in which the absorption continuously increases from one end to the other, a measurement of the light intensity at six or eight parts of the spectrum is quite sufficient, in order to construction of the whole absorption curve, and determining the relation of absorption to the wave-length of the light.—Attention is directed to some new physical phenomena: thus M. Kundt has observed a well-marked dichroism in certain substances (such as caoutchouc and gutta-percha) on stretching. Examined with a dichroscopic lens a thin strip gave two images, one dark brown, the other nearly straw-yellow; the ray whose vibrations are in the direction of stretching is the most absorbed.—M. Antolik studies what he calls the "gliding" of electric sparks; a phenomenon which is had, if *e.g.* a spark be made to strike a soot-smeared glass ball. The path-trace left by the spark shows two light parallel lines, and a dark one between; the former are due to thrusting aside of the soot, and, in the dark band, the soot seems compressed, for, on washing the globe, the soot remains there after the rest has gone. The outer edge of the light band shows, in the microscope, a number of dark and light triangles, apparently produced by induction.—M. Obermayer describes phenomena presented by the dispersion of some solutions of aniline colours in water.—M. Edlund rejects, as inadequate, a recent experimental investigation, by Prof. Roiti, of the question: Is the galvanic current an ether current? and M. Reye replies to M. Zollner on the subject of sun-spots and protuberances.—A Japanese toy-bird is the topic of a note by M. Erdmann. The bird is placed with its back on a board, by means of which it is thrown forward; and after rising 8 ft. or 9 ft. in a parabolic curve, it returns, head foremost, to the thrower.—M. Nordenskjold furnishes some particulars as to the nature of cosmic dust which had been observed to fall, with atmospheric precipitates, in the neighbourhood of Stockholm.—Among the matter selected from other serials we may note an account of M. Wiedemann's researches on the elliptical polarisation of light, and its relation to the surface colours of substances; and remarks on the arrangement of a *dispersiometer*, by M. Mousson.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 23.—Note On the minute anatomy of the alimentary canal, by Herbert Watney, M.A., Cantab. Communicated by Dr. Sanderson, F.R.S., Professor of Practical Physiology, University College.

Zoological Society (anniversary), April 29.—Viscount Walden, F.R.S., president, in the chair.—The report of the council, which was read by the secretary, Mr. P. L. Sclater, F.R.S., stated that the number of ordinary members of the Society on January 1 last was 3,173, of foreign members 25, and of corresponding members 196.—The total income of the Society in 1873 was 28,099*l*., being 1,371*l*. more than that of 1872, and exceeding the income of any previous year, even those of the years 1851 and 1862, when the Great and International Exhibitions were held, which have hitherto been regarded as exceptional years. The total ordinary expenditure of 1873 had been 22,721*l*., and 4,945*l*. had been likewise devoted to extraordinary expenditure, leaving a balance of 1,384*l*. to be carried forward for the benefit of the current year. The assets of the Society on December 31, 1873, were calculated at 10,530*l*., while the liabilities were reckoned at 5,490*l*. The reserve fund consisted at the close of the year of a sum of 8,000*l*. reduced three per cents., but it had been resolved to increase this fund by investing the interest of it from time to time, and by purchasing a further sum of like stock to the amount of 500*l*. every year. The scientific publications of the Society for 1873 had consisted of the usual octavo volume of "Proceedings," and of three parts of quarto "Transactions." The most important work undertaken in the Society's gardens in 1873 had been the rebuilding of the main refreshment-room in the South Gardens at a total cost of 2,096*l*. The total number of visitors to the Society's Gardens in 1873 had been 713,046, being 64,958 more than the corresponding number in 1872, and exceeding that of any previous year since the Gardens had been open to the public. The number of animals in the menagerie on December 31, 1873, was 2,187. Many of the accessions during the year had consisted of specimens of rare or little-known animals, of which full particulars were given. The report concluded with a long list of donors and their several donations to the menagerie. The adoption of the report was moved by Mr. J. Stewart Hardy, M.P., seconded by Prof. Tennant, and carried unanimously. The meeting then proceeded to elect the new members of council and the officers for the ensuing year, and, a ballot having been taken, it was found that Viscount Walden, F.R.S., had been elected president, Mr. Robert Drummond, treasurer, and Mr. P. L. Sclater, F.R.S., secretary to the Society. The new members of council elected were Robert Hudson, F.R.S., the Marquis of Ripon, K.G., Lord Arthur Russell, Osbert Salvin, F.R.S., and Lord Walsingham.

Anthropological Institute, April 28.—Prof. Busk, F.R.S., president, in the chair.—Mr. H. H. Howorth read a paper, entitled Strictures on Darwinism; part 3, on Gradual Variation. The paper was in continuation of a series in which the author endeavoured to show that Mr. Darwin's main conclusion is not supported by the evidence of the changes of type that can be examined. Mr. Darwin differed from the older naturalists in assigning, as the cause of variation, a struggle between the individuals of a class for existence by which a favoured individual and its progeny eventually survive. They, on the contrary, argued that variation is induced by a change in the external conditions of climate, food, &c., which operate upon the whole class together and make it change, as a whole, in a certain definite manner and direction, that is in one which can be actually predicted. So that if any individual of a class or any number of individuals of a class be subjected to a certain alteration of conditions, a certain definite and uniform change will be produced in the individual or the class. Again if the new conditions were annihilated, the object of the experiment is reverted to its original surroundings. The author supported that argument by a large number of facts, and in doing so was constrained to conclude that the operating cause of variation in man, as in the case of plants and animals, is the working of external causes; and that an individual with its progeny is not so much better fitted for enduring the new conditions that it eventually supplants the rest, but rather that the whole class is moulded together into a new shape, which is called a new variety. Some facts were drawn from the experience of history showing that where the conditions have been uniform, as in Egypt, although there has been a considerable mutual pressure among the individuals of a class for food, &c., yet there has been no variation, while a transplanting of similar individuals, as in the case of European emigration to America, has been followed by almost immediate change. The illustrations that might be drawn from the cases of man, as in the changes that have ensued in both the Aryan and the black emigrants to North America, of the Dutch to the Cape, of the Portuguese to South America, &c., were notable and telling instances of the operation of the law argued for by the author, inasmuch as changes of type of a marked character have occurred where there has been neither time nor opportunity for the creation of a fresh type by the successive amelioration or change in the idiosyncrasies of the descendants of a common ancestor; but where the change has undoubtedly occurred in the whole class together over a very wide area.

DUBLIN

Royal Irish Academy, March 16.—Rev. J. H. Jellett, B.D., president, in the chair.—The minutes of the previous meeting having been read and confirmed, Dr. Ingram, secretary to the council, read the annual report, which referred to the work done by the Academy during the previous session, the state of the museum, &c. Seven members were lost by death during the year.—At the conclusion of the report, a ballot took place for the election of president and council. Dr. Stokes, F.R.S., was declared duly elected president, and the following officers were elected:—J. R. Garstin, LL.B., treasurer; E. Perceval Wright, M.D, secretary; J. T. Gilbert, librarian, and Dr. R. M'Donnell, F.R.S., secretary of foreign correspondence.

April 13.—Dr. Stokes, president, in the chair.—A paper was read by M. Donovan On some Improvements of a Comparable Self-acting Hygrometer.—John Casey LL.D., read a paper On a new method of finding the Equation of the Squares of the differences of the roots of a Biquadratic, given by its general equation.—Mr. H. W. Mackintosh read a paper On the Anatomy of the Coatimondis and Marten. During the summer of last year two species of the coatimondi (*Nasua narica* and *N. fusca*), and two specimens of the common species of marten (*Martes foyna*), which formed part of the collection in the Dublin Zoological Gardens, having died, were obtained for the Dublin University Museum, and through the kindness of Dr. Macalister I had the opportunity of assisting him in dissecting them. *Nasua narica*, as doubtless many are aware, has a very long and flexible snout, and hence we found the facial muscles correspondingly better developed in it than in the others. Trapezius, which is tripartite in all, is remarkable in *N. fusca* for sending from its clavicular portion a slip to the humerus and also for being joined to brachialis anticus. Omohyoid was completely absent in the Coatis, but represented by a fine muscular band in Martes. Teres major is remarkable in Martes for being inserted into the humerus free from the tendon of the latissimus dorsi. Pectoralis major has the usual band from the presternum to the humerus; in *N. fusca*, besides the two laminæ from the whole sternum, and from the mesosternum respectively to the pectoral ridge, and greater tuberosity of the humerus, there was a third portion arising from the abdominal parietes and inserted below the humeral tuberosity. The clavicle being rudimentary, the subclavius, as is generally the case amongst carnivores, had disappeared. Acromial deltoid in *N. narica* has some of its fibres continuous with those of brachialis anticus. There was a perfectly separate prescapular slip of subscapularis in *N. fusca*, but not in the other two pronater radii teres passes in all to be inserted below the distal half of the radius. The extensor of the little finger sends tendons to the third and fourth, as well in *N. fusca* and Martes; but in *N. narica* there is a separate extensor *quarti et tertii digiti*. In the hind limb, sartorius has a double insertion into the tibia and into the patella and femoral condyle, the former segment being fused with gracilis. *N. narica* has a distinct agitator caudæ, which is represented in the marten by the caudal origin of the biceps femoris. Bicipiti accessorius is distinct in the Coatis, but inseparable from triceps in Martes, in which also gastrocnemius externus and plantaris are fused. Tibialis anticus is double in Martes, one part arising anterior to the other and being inserted beside and separate from it.—Dr. Collins read a paper On accessory Lobes of the Human Lung. The specimen exhibited presented an accessory lobe of the right lung, lying above the root, and invested by a pleural duplicature, which contained in its lower free margin the azygos vein, and in its external border the superior intercostal. Reference having been made in detail to seven similar cases noticed in different parts of Europe, special stress was laid upon a unique case detailed by Wrisberg of a lobe having similar relations upon the left side, as conclusively establishing the mode of origin of the lobe in connection with the development of the azygos, and superior intercostal venous systems. The author regarded these as the only true accessory lobes yet described in man. Mention was made of other so-called accessory lobes, particularly one described by M. Pozzi, below the right bronchus, from its apparent homology to the mammalian lobus impar, and a similar one upon the left side, described by Prof. Recktorzik. These, however, the author regarded as merely higher developments of pulmonary notches, which in not a few instances are normally to be found. The paper, which was illustrated by the recent specimen and by drawings, concluded with an allusion to accessory bronchi in their connection with the subject.

PARIS

Academy of Sciences, April 27.—M. Bertrand in the chair.—The following communications were read:—Fourth memoir on chemical dynamics, by M. Becquerel, a continuation of the author's electro-chemical researches.—On freezing mixtures, by M. Berthelot. The author concluded, from his researches, that by application of the resources indicated by theory, a much lower temperature ought to be obtained than has hitherto been reached.—Study and experiments upon sulphides: alkaline sulphides, by M. Berthelot, a continuation of the author's thermo-chemical researches.—M. Kronecker contributed an algebraical paper on quadratic and bilinear forms.—Note on the decomposition of the work done by forces, M. A. Ledieu. The author gave a rigorous enunciation of Luca's theorem relating to the division of the work done by forces in a material vibrating system.—The production of gum in fruit trees considered as a pathological phenomenon, by M. E. Prillieux. Trees affected by this malady were stated to be cured by making longitudinal incisions in the branches.—On unicursal curves, a geometrical memoir by M. Painvin.—Orbit of the double star γ Virginis, by M. C. Flammarion. This system offers the unique case of an elliptical orbit facing us in a plane exactly perpendicular to the line of sight, so that no distortion of the ellipse due to perspective is perceived.—On the conclusions to be drawn from the application of thermo-chemical theorems to explosive bodies in general and to gunpowder in particular, by M. F. Castan.—On the thermal conductivity of rocks and of bodies in general, by M. E. Jannettaz. The law which regulates the propagation of heat in crystals appears to the author a particular case of the general law that heat is propagated most easily in the direction of least cohesion.—Determination of the age of the human embryo by the examination of the evolution of the dental system, by M. E. Magitot. The results are likely to be of great service in medico-legal cases.—M. E. Combescure presented a note on a theorem concerning simultaneous partial differential equations.—Direct construction of the radius of curvature of the curve of apparent contour of a surface projected orthogonally on a plane, by M. A. Mannheim.—On the limit of the degree of the primitive groups which contain a given substitution, a mathematical note by M. C. Jordan.—Elements and ephemerides of the planet (127), by H. Renan.—On the elementary law of electrodynamic actions, by M. J. Moutier.—Observations on Tyndall's experiments on the acoustic transparency and opacity of the atmosphere, by M. Bandriment. The author stated that the given explanation of the phenomenon of acoustic extinction might be true, but did not seem sufficiently demonstrated to be admitted without submission to a special inquiry, and concluded by stating that the observations were made to be considered by Prof. Tyndall only as means offered to him for the verification of facts of such great importance.—Study of the properties of explosive bodies, by F. A. Abel.—On the employment of oxygen mixed with atmospheric air in respiration, by M. A. Gandin. The author confirmed the results obtained by MM. Crocé-Spinelli and Sivel in their last balloon ascent.—On a burying-place of the ancient Troglodytes of the Pyrenees superposed upon a (funeral) hearth containing human remains associated with sculptured teeth of the lion and bear, by MM. L. Lartet and Chaplain-Duparc.

BOOKS RECEIVED

BRITISH.—Physiology for Practical Use 2 vols. Edited by James Hinton (H. S. King & Co.).—A Treatise on Food and Dietetics: Dr. Parry (Churchill).—Sanitary Arrangements for Dwellings: W. Eassie (Smith, Elder & Co.).—Thorpe's Qualitative Chemical Analysis (Longmans).—Principles of Mechanics: Goodeve (Longmans).—Year Book of Facts: Timbs (Longmans).—Surface Zones of the Globe: Keith Johnston (W. & A. K. Johnston).—Lectures on Experimental Chemistry: Prof Reynolds (Hodges, Foster & Co.).—Mechanics: Willson (Thacker).—Pickering's Physical Manipulation (Macmillan).—Physiology: F. de Gros Clark (S.P.C.K.).—Geology: T. G. Bonney (S.P.C.K.).—Africa: A. Gruar Forbes (Low & Co.).—Proceedings of the Royal Society of Edinburgh.

AMERICAN.—The Constants of Nature. Part I. (Smithsonian Institute). Compiled by F. W. Clarke, S.B.—A History of American Birds: S. F. Baird, T. M. Brewer, and R. Ridgway (Little, Brown & Co.).—The Unity of Creation: F. K. Kingston (Trübner).

COLONIAL.—General Report of the Great Trigonometrical Survey of India during 1873: Col. J. T. Walker (Dehra Doon).—Geological Survey of Canada. Report for 1873: (Dawson).—Report of the Secretary for Agriculture, Victoria.—Transactions of the Royal Society of Victoria.

FOREIGN.—Statique des Liquides. 2 vols. J. Plateau (Gauthier Villars).—Association Française. 1st session. Comptes Rendus.—Histoire de la Creation: E. Haeckel (Reinwald, Paris).—Schriften der Naturforschenden Gesellschaft in Danzig. 1873.—Les Explorations Sous-Marines.—Elements de Geologie et de Paleontologie: Ch. Contejean (Baillière).—Principes de Geologie: Gustave Dollfus (Savigi, Paris).—Verhandlungen Zoologisch Botanischen Gesellschaft in Wien, Band xxiii.

CONTENTS

PAGE
LEWES'S "PROBLEMS OF LIFE AND MIND." By DOUGLAS A. SPALDING 1
OUR BOOK SHELF 2
LETTERS TO THE EDITOR:—
Necessary Truths—Physical and other.—HERBERT SPENCER . . 3
Royal Society Soirée.—P. L. SCLATER, F.R.S. 3
Father Secchi's Work on the Sun.—P. R. SECCHI 3
Spontaneous Generation Experiments.—Dr. LEONARD W. SEDGWICK 4
The Fertilisation of Fumariaceæ.—J. TRAHERNE MOGGRIDGE; Dr. HERMANN MULLER, Prof. W. T. THISELTON DYER . . . 5
Fertilisation of Corydalis claviculata.—W. E. HART 5
Lakes with two Outfalls.—Col. GEORGE GREENWOOD; W. A. B. COOLIDGE 5
Trees "Pierced" by other Trees.—J. HERSCHEL 6
The Antipathy of Spiders to the Wood of the Spanish Chestnut . 6
FLOWERS OF THE PRIMROSE DESTROYED BY BIRDS 6
THE LECTURES AT THE ZOOLOGICAL SOCIETY'S GARDENS, III. . . . 7
CAMPHOR. By JOHN R. JACKSON 8
THE "SPAR CAVES" OF THE NORTH BRIDGE, EDINBURGH. By Prof. GEIKIE, F.R.S. 8
REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL," III. (*With Illustrations*) 9
THE COMING TRANSIT OF VENUS, III. (*With Illustrations.*) By Prof. GEORGE FORBES 11
NOTES 14
THE METEOROLOGICAL CONGRESS AT VIENNA 17
SCIENTIFIC SERIALS 18
SOCIETIES AND ACADEMIES 19

THURSDAY, MAY 14, 1874

THE SCIENCE COMMISSION

IT would be difficult, we think, to overestimate the value of the evidence brought together in the second volume published by the Science Commission. The first volume dealt mainly with the diffusion of knowledge; the second is concerned mainly with the advancement of Science. The Commission has done good service in bringing before Parliament and the country the carefully weighed opinions of men of the highest mark in all departments of Science on subjects of the first importance, not only in their bearing on the advancement of Science but also on some of the best interests of this country. We propose to show the general bearing of the evidence contained in the volume on some of the questions on which the Commission sought information, omitting all opinions of our own.

The unanimity of opinion among the witnesses examined—and their number is large—as to the duty of the State in the matter of Abstract Science is striking; without exception, so far as we have been able to examine the evidence, the opinion is unanimous that it is the duty of the State to encourage original research in Abstract Science. As might naturally be expected opinions vary as to the method which the State should adopt in carrying out this duty, but that some action ought to be taken by the State in this direction is the all but unanimous conviction of the best men in all departments of Science. We need only mention in this connection such names as those of Lord Derby, Lord Salisbury, Sir Stafford Northcote, as statesmen, Sir Wm. Thomson, Dr. Joule, Dr. Sanderson, Col. Strange, Mr. George Gore, Dr. Carpenter, Mr. T. H. Farrer, Prof. A. W. Williamson, Dr. Frankland, Mr. E. J. Reed, General Sir Edward Sabine, Prof. Balfour Stewart, Prof. Owen, Admiral Richards, Dr. C. W. Siemens, Mr. P. L. Sclater, Dr. Hooker, Dr. De la Rue, &c., to show the weight and comprehensiveness of opinion on this point, and that it is held not only by men concerned solely with Abstract Science but also by those concerned with some of the most important practical applications of Science.

Of course the principal way in which the State can aid scientific research is by granting money for the purpose; as to how such a grant ought to be applied various opinions are offered by the witnesses, each witness, as a rule, naturally looking at the matter from the point of view of his own branch of Science, but all are decidedly of opinion that a very large sum should be put on the estimates annually for the promotion of Science. Nearly all the witnesses who have been examined on this point are of opinion that Government, under judicious advice, ought to make grants to existing scientific institutions, to university laboratories, and to private individuals, to enable them to carry on research that is likely to lead to valuable scientific results. In addition to this, however, such men as Sir Wm. Thomson, Dr. Frankland, General Strachey, Prof. Owen, Dr. Joule, Dr. De la Rue, Dr. Carpenter, Col. Strange, Mr. Gore, and others, express a most decided conviction that one of the most efficient methods by which Government could further research in this country is by the establishment of public laboratories for the pursuit of scientific research in connection with the various and ever-multiplying departments of Physics, Chemistry, and Biology, adequate research in connection with which is admittedly quite beyond the means of private individuals. The evidence in favour of institutions of this kind is very strong indeed whether we consider the number and position of the witnesses or the earnestness and decision with which they express their convictions. It is clearly stated that in this country we are very far behind continental states and America in this respect, and that not only is Science a loser from want of assistance from the State, but the general welfare of the country is seriously impeded. The evidence in favour of the establishment of State institutions for the prosecution of scientific research is so voluminous and strong that it is difficult to select any particular part for quotation. As an example of its nature, however, we may quote what Dr. De la Rue says on the subject of chemical laboratories:—

"I hold it to be so important that chemistry should be extensively cultivated in England, that I would strongly advocate that there should be a State laboratory. That State laboratory should undertake all the chemical work which the Government might require; but at the same time, according to the views which I hold, it ought to be such an establishment as could afford facilities to men who have completed their scientific education, and who might be desirous of continuing original investigations, in which space for working and instruments should be afforded them, and, moreover, if men were not in a position of fortune to continue their researches, in some cases materials and even money might be granted to them on the recommendation of the Council. I may state that of my own knowledge I know that chemical science at present is not progressing in England in a satisfactory manner, that we do not make so many original researches as our continental neighbours, particularly the Germans, do. In Germany very great patronage is given to Science, magnificent laboratories have been built, and the students, who after they are sufficiently advanced are encouraged to make original investigations, contribute at present most largely to scientific chemistry."

On the question of establishing a Public Physical Laboratory, Col. Strange says:—

"I think it is an absolute necessity on the ground of my second postulate, in which I say that all science should be cultivated, even branches of Science which do not appear to promise immediate advantage. It is one of the most important parts of Science, and cannot be omitted without detriment to all the other parts. . . . . Investigations connected with almost the whole of our material economy are required. There is no question connected with sanitary improvement, with water supply, or sewage, or telegraphy, or the enormous number of the requirements of the army and navy, which would not derive advantage more or less from investigations of a physical nature such as would be conducted in a physical laboratory. I think that the whole of our naval and military and social economy is dependent upon investigations such as would be carried on in a physical laboratory."

A similar tone pervades the evidence of the witnesses who were questioned on the subjects of physiological and biological laboratories, metallurgical laboratories, botanical laboratories, and observatories for astronomical physics. Of those in favour of an observatory of the last-mentioned kind, we might mention the names of Lord

P20348

Salisbury, Lord Derby, Sir William Thomson, Prof. Balfour-Stewart, Admiral Richards, Dr. Siemens, Dr. Joule, General Strachey, Dr. Frankland, besides many others.

This may suffice to show the nature of the evidence as regards the duty of the State in the matter of Abstract Science and the method by which this duty should be performed. In minor details, of course, there are differences of opinion, but the weight of evidence is without doubt in favour of the establishment of scientific laboratories by the State, in addition to the encouragement of suitable private individuals and the subsidising of existing institutions. Most seem to be of opinion that at first central laboratories should be established in London only, to be afterwards extended to the provinces, and most of those examined on the subject expressed their decided conviction that the men who gave up their time to the service of Science and the State in these laboratories or elsewhere should be adequately remunerated, indeed be regarded as a superior class of Civil servants. For example, Lord Salisbury, on the question of income, suggests that men who might be appointed to pursue original research by the State ought to have an income of about 1,000*l.* or 1,500*l.*, with a provision for retirement. Other witnesses who spoke in favour of paying public researchers were Lord Derby, Dr. Joule, Sir William Thomson, Sir E. Sabine, Sir Stafford Northcote, Dr. Siemens, Mr. Gore, the late Prof. Rankine, &c.

In order that the State may look after the interests of Science and the scientific interests of the country, it would of course be necessary that some well-organised system should be adopted by which the intentions of the State should be carried out. The great majority of those examined on this point agree that this would be best accomplished by the establishment of a State Council of Science presided over by a Minister of Science, who, however, some are of opinion might also be Minister of Education. But that a special department, or at the least, a sub-department of the State should take the promotion of Abstract Science and Science in its practical bearings on the interests of the country under its wing, seems to be the opinion of the great majority of those whose opinion was asked by the Commission on this question; and they include many of the men most eminent in Abstract as well as Applied Science. This State Council of Science, as we have indicated, is not meant solely to look after the interests of abstract scientific research in the country; its time would be much, if not a great deal more, occupied in bringing to a scientific test and advising Government upon all Government projects in which scientific principles are more or less involved. All are agreed that the cost to the country of such a Council would be nothing compared to the losses which are being continually sustained through the haphazard projection and carrying out of schemes that fail wholly or partially from not being founded on strictly scientific principles. Several of the witnesses, for example, refer to the unfortunate *Captain*, whose blundering construction would have been impossible had the Government had such a Council to consult. As to the size and composition of such a Council, opinions of course differ, though many of the witnesses referred with more or less approval to the long-thought-over and well-matured scheme of Col. Strange.

As to some of the duties which would devolve upon such a Council, we cannot do better than quote from Sir William Thomson's evidence, merely reminding the reader that his statement is typical of the opinions held by most of the other witnesses who spoke to the question:—

> "The main object of such a Council would, in my opinion, be to advise the Government on all scientific questions which might come under the attention of the Government, and on all scientific works actually undertaken. With a vast amount of mechanical work which is necessarily undertaken by the Government, and which is continually in hand, questions involving scientific difficulties of a novel character frequently occur: questions requiring accurate knowledge of scientific truth hitherto undeveloped are occurring every day. In both respects Government is at present insufficiently advised, and the result is undoubtedly that mechanical works are sometimes not done as well as they might be done, that great mistakes are sometimes made: and, again, a very serious and perhaps even a more serious evil of the present system, in which there is not sufficient scientific advice for the Government, is the undertaking of works which ought never to be undertaken. . . . One great mistake undoubtedly was the construction of the *Captain*, and I believe that a permanent scientific Council advising the Government would have made it impossible to commit such a mistake. They would, in the very beginning, have relieved the Government from all that pressure of ignorant public opinion which the Government could not possibly, in the present state of things, withstand."

On the question as to whether such a Council would command sufficient public confidence among men of Science, the answer of Mr. P. L. Sclater, F.R.S., may be taken as embodying the opinion of most of the other witnesses. He says:—"I have no misgivings at all upon that subject. I should say that they would meet with general support from men of Science. Most men of Science, I think, see that something of the sort is imperatively required. All lament the piecemeal way in which scientific subjects are dealt with by Government, in consequence of their being subdivided amongst all these different offices, and of there being nobody to appeal to upon a question of Science, and, therefore, I think the proposal to establish such a Council would meet with universal acceptation amongst scientific men."

Into the questions of the size of the Council, whether the members should or should not be appointed for life, &c., we need not enter here; the great point is that the mass of evidence is in favour of establishing such a Council, presided over by a Minister of Science.

The question of the institution of a State Minister of Science has been so often discussed in these pages that we need not go into the voluminous evidence in its behalf which is published by the Commission. While some of the witnesses think that such a Minister's functions ought also to include the department of Education, most of them point out that Britain is the only country in which the interests of Science have no representative in the Government of the country.

It will thus be seen that the Commission has been the means of eliciting from the various eminent men who have come before it a complete and comprehensive scheme for the promotion of Science by the State, and for giving Government the means of obtaining trustworthy counsel in all matters in which scientific principles are in any way involved. In the main features of the scheme nearly all the witnesses who were examined on the subject are at one; many of the details in which they differ are of such a nature as can be settled only by actual trial.

On the many other subjects touched upon in the volume we cannot enter here. Much of the evidence bearing on the Universities tends to prove that the interests of Science are inadequately attended to in these institutions, and that the scientific teachers in some of them have to contend with very great difficulties. With respect to what Universities should do to advance the interests of Science, not to speak of the utilisation of the enormous funds at the disposal of Oxford and Cambridge, such men as Dr. Siemens, Dr Frankland, Dr. Sanderson, and others are of opinion that for the highest degrees in Science original research should be required; Prof. Balfour-Stewart thinks that Universities ought to afford facility for the prosecution of original research, and Dr. Carpenter that University Fellowships should be given to men employed in original research.

Many of the most eminent witnesses—as Sir B. Brodie, Lord Salisbury, Dr. Frankland, Prof. Williamson, Colonel Strange, Sir William Thomson, &c.—are of opinion that research ought to be endowed quite apart from teaching in the ordinary acceptation of the term.

Most of the witnesses who spoke to the condition of Science in this country contrasted it with the great encouragement given to research in nearly every other European country, and in America. In this relation we cannot help quoting a very striking statement made by Sir William Thomson in respect to France, in answer to the question as to how many institutions for research he would recommend.

"There should be five," he says. "One at present exists, namely, the Royal Observatory at Greenwich. Another in my opinion is very much wanted, an observatory for astronomical physics; then again a physical laboratory, and a laboratory for chemical research, and a physiological laboratory are necessary. In respect of such institutions, I believe, we might with great advantage obtain information, with a view to following example, in Paris. The strong feeling of the necessity to promote scientific research which was evinced shortly after the recent sad disasters which came upon France illustrates very strongly the national value of such institutions. In the depths of their misfortunes, one of the first strong feelings shown by the most intelligent part of the French nation was the want of rigorous and accurate scientific research. Competitive examinations seemed in France to have swallowed up scientific energy, and there was a strong feeling of the insufficiency of the national institutions for promoting the advancement of Science."

In conclusion, we cannot do better than quote the forcible and noble language of Sir William Thomson, on the much-discussed question of the "utility" of abstract scientific research. To the question as to some of the objects to be gained by the establishment of a Council of Science, Sir William Thomson replies:—

"The immediate utility of the work is undoubtedly a very important object, and perhaps may be considered to be the first duty of the Government; but yet there is another duty which, although we cannot call it the first duty, is certainly not an inferior duty, and that is, to promote the honour of this country. There can be no doubt but that the inhabitants of this country do get benefit from the feeling of satisfaction that naturally results from any great scientific discoveries or great advances in Science made by their own countrymen, and especially by the assistance of their own Government. The Royal Observatory at Greenwich is an honour and a glory to this country, and I am quite sure that the money paid for it is very well spent, in the satisfaction that the country feels in the honour of having one of the greatest and best, if not *the* greatest and best, of scientific astronomical observatories in the world. This country undoubtedly has a great permanent possession in the name of Newton and in the name of Faraday. The promotion of scientific research in a regular way cannot make Newtons and Faradays, but it can obtain great scientific results by systematic business-like action, carried out through well-instructed and able men. It seems to me to be a duty of the Government to make the national honour in scientific investigation a subject of its solicitude and an occasion (with due safeguards against abuse) for spending the public money."

J. S. K.

OUR BOOK SHELF

Proceedings of the London Mathematical Society, vol. iv. Nos. 41-66. (Messrs. Hodgson, Gough Square.)

THE volume before us contains the papers which have been read during the eighth and ninth sessions of the Society. We notice a favourable sign in the much greater number of contributions which have been made in the later session—36 against 15. A large number of the members have been led to take an interest in the meetings, and the papers without losing their former high character are in some cases less "caviare to the general" than in previous volumes. The Society's first president himself thus wrote, "Not a drop of liquor is seen at our meetings, except a decanter of water; all our 'heavy' is a fermentation of symbols, and we do not draw it mild. There is no penny fine for reticence or occult science; and as to a song! not the ghost of a chance." The Society, however, as we see, has reached its tenth year; and though some of the members drop off for reasons which perhaps may be gathered from our quotation, yet the number of members recorded in this volume is fairly satisfactory: the present number of members of the Mathematical Society is about 117. In Paris the new Society (la société mathématique de France) started with almost double this number of members. So far as we have seen, however, the papers of the volume under notice and of previous volumes will not lose by a comparison with the opening numbers of the younger society's *Bulletin*. Of course no volume would fairly represent English mathematics without having contributions from Prof. Cayley's fertile pen; here we have no less than ten papers, some of considerable length, principally on curves and surfaces, and constructions for mechanically describing the former.—Dr. Sylvester furnishes only short notes on the properties of numbers.—Prof. H. J. S. Smith contributes an arithmetical demonstration of a theorem in the integral calculus, and two other papers bearing upon linear congruences and determinants.—Prof. W. K. Clifford writes, among other things, upon geometry, on an ellipsoid, and a new form of Biquaternion.—Mr. Samuel Roberts rivals Prof. Cayley in the extent and nature of his communications upon parallel surfaces, and also upon epi- and hypo-trochoids.—Prof. Clerk-Maxwell takes us to another sphere, and treats of the transformation of solids, of the equations of motion, of a system of electrified conductors, and of the focal lines of a refracted pencil.—Lord Rayleigh too takes us into the domain of physical science, in his vibrations in a sphere, the investigation of the disturbance produced by a spherical obstacle on the waves of sound, general theorems relating to vibrations.—A presidential address by Mr. Spottiswoode treats of some recent generalisations of algebra.—Mr. J. W. L. Glaisher writes on

Bernoulli's numbers, and on points connected with definite integrals.—Prof. Wolstenholme's papers are concerned with series and loci, and treat also of epicycloids and hypocloids.—Mr. T. Cotterill gives a short paper on an algebraical form and the geometry of its dual connection with a polygon, plane or spherical.—An analogous theorem relating to polyhedra is discussed by Prof. Clifford in this same volume.—M. Hermite contributes two short notes, one on circular functions, the other on unicursal curves.—Mr. J. J. Walker writes on the invariant conditions of multiple-concurrence of two conics, and Mr. R. B. Hayward on an extension of the term *Area* to any closed circuit in space.—From this analysis it will be seen that there is considerable variety in the contents of the volume. It is not necessary here to give any detailed account of the papers, as notices of them have appeared from time to time in our columns.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

Flowers of the Primrose destroyed by Birds

I HOPE that you will permit me to make a few final remarks on the destruction of primrose flowers by birds. But first I must return my best thanks to your correspondents, as well as to some gentlemen who have written direct to me, and to whom I have not had time to send separate answers. Secondly, I must plead guilty to the high crime of inaccuracy. As the stalks from which the flowers had been cut were shrivelled, I mistook, in a manner now inexplicable to me, the base of the ruptured or removed ovarium for the summit; a remnant of the shrivelled placenta being mistaken for the base of the pistil. I have now looked more carefully, and find that on twelve stalks only three had any remnant of the ovarium left. I have also examined sixteen bits of the calyx which had been cut off by a caged bullfinch, presently to be noticed, and in fifteen of these not only had the ovarium been torn into fragments or quite destroyed, but all the ovules had been devoured, excepting sometimes one or two. In several cases the calyx had been split open longitudinally. The ovarium was in the same state in thirteen small portions of the calyx lying on the ground near a wild cowslip plant. It is therefore clear that the ovules are the chief attraction; but the birds in removing by pressure the ovules could not fail to squeeze out the nectar at the open end, as occurred when I squeezed similar bits between my fingers. The birds thus get a dainty morsel, namely, young ovules with sweet sauce. I still think that the nectar is, in part, the attraction, as caged bullfinches and canary birds much like sugar; but more especially because Mr. C. J. Monro has sent me some flowers from a cherry-tree near Barnet, which during several years has been attacked; and he finds many of the flowers, both those on the tree and on the ground, with rather large ragged holes in the calyx, like, but much larger than, those often made by humble bees when they rob flowers in an illegitimate manner. Now the inside of the flower of the cherry, round the ovarium, is bedewed (if protected from the visits of insects) with drops of nectar, which sometimes collect so as almost to fill up the bottom of the flower. In the case of the cherry I cannot doubt that this is the attraction, for I examined the ovarium of ten flowers, and although they had all been scored by the bird's beak, and in four instances punctured, the ovule had in no case been devoured.

To return to the primroses: from the accounts received, it seems that the flowers are cut off in the manner described by me, near Preston in Lancashire, in North Hampshire, Devonshire, and Ireland, as well as in Kent. In several other places, not worth specifying, where primroses are abundant, they have not been thus attacked; and this may possibly be due to the proper enemy, namely, as I now suspect, the bullfinch, not being a common bird. In my former letter I remarked that if the habit of cutting off the flowers proved to be a widely extended one, we should have to consider it as inherited or instinctive; as it is not likely that each bird should discover during its individual lifetime the exact spot where the nectar, and, as I must now add, the ovules, lie concealed, or should learn to bite off the flower so skilfully at the proper point. That the habit is instinctive, Prof. Frankland has given me interesting evidence. When he read my letter he happened to have in the room a bunch of cowslip flowers and a caged bullfinch, to whom he immediately gave some of the flowers, and afterwards many primrose flowers. The latter were cut off in exactly the same manner, and quite as neatly, as by the wild birds near here. I know that this is the case by having examined the cut-off portions. The bird worked so quickly that he easily destroyed twenty flowers in three minutes; a single wild pair would therefore cause great havoc. Prof. Frankland informs me that his bird pressed the cut-off portions of the calyx in its beak, and gradually worked them out on one side, and then dropped them. Thus the ovules were removed, and the nectar necessarily squeezed out. A canary bird to whom some cowslip and primrose flowers were given attacked all parts indiscriminately, and ate up the corolla, calyx, and stalks. A lady also informs me that her canary and siskin always attack primrose and cowslip flowers, if kept in the same room. They generally first make a ragged hole through the calyx opposite the ovarium, and remove the ovules, as I found to be the case with flowers which were sent to me; but the ovules had not been so well removed as by the bullfinch, and the nectar could not be obtained by this method of attack.

But now comes the interesting point: the caged bullfinch just referred to was caught in 1872 near Ventnor, in the Isle of Wight, soon after it had left the nest, by which time the primroses would have been out of flower, and since then, as I hear from Prof. Frankland, it had never seen a primrose or cowslip flower. Nevertheless, as soon as this bird, now nearly two years old, saw these flowers, some machinery in its brain was set into action, which instantly told it in an unerring manner how and where to bite off and press the flowers, so as to gain the hidden prize. We are reminded by this little fact of Mr. Spalding's admirable observations on the instinctive actions of chickens when their eyes were uncovered, after having been blind-folded from the moment of being hatched.

Prof. Frankland seems to have been much struck with the behaviour of his bullfinch, and remarks in his letter that "it had all the precision of a chemical reaction; the result of putting a primrose within its reach can be almost as certainly predicted as that of putting a plate of iron into a solution of sulphate of copper." CHARLES DARWIN

Down, Beckenham, Kent, May 7

P.S.—This letter was printed before I saw your last number, and I am glad to find that some of my statements are confirmed, more especially with respect to bullfinches. During the last fortnight not one primrose has been attacked in the little wood where shortly before there was such havoc. I imagined that the pair of bullfinches, which I saw there earlier in the season, had wandered away; but yesterday evening (May 10) it occurred to me that the flowers produced late in the season might fail to secrete nectar, or that the recent cold weather might have produced this effect. Accordingly, in the afternoon I gathered fifteen flowers from as many distinct plants, and kept them in water in my room for seventeen hours. Earlier in the season I treated some flowers in this same manner, and found the tube of the corolla full of nectar; but now only one of the flowers contained a very small quantity of nectar, another showing a mere trace of it. And the flowers being no longer cut off by the birds supports my belief that the nectar is one chief attraction to them; the ovules without the sauce not being worth the gathering. I may add that as the primrose is a dimorphic plant, these non-nectariferous flowers would be sterile, for they would not be visited by insects.—C. D.

Mr. Spencer and *à priori* Axioms

I QUITE agree with Mr. Spencer that argument between us will not be to much purpose; but it should be noted that my principal "exemplification of unconsciously-formed preconceptions" was of Mr. Spencer's own choosing, namely, Newton's "Second Law of Motion," which, if I understand him aright, may now be described as "a consciously-formed hypothesis concerning the relation between weight (force?) and motion." Only demurring to the word "hypothesis," and leaving it to Mr. Spencer to reconcile this with his former declaration that the law in question is an "immediate corollary" of one of these unconsciously-formed preconceptions, it seems to me there is little left to argue about.

ROBT. B. HAYWARD

Harrow, May 8

MR. SPENCER does not state his arithmetical illustration very exactly. He implies that there is a certain truth which the savage is incapable of understanding concerning which the schoolboy makes a mistake, but that there is present in the civilised adult a consciousness of its logical necessity. It does not appear distinctly what that truth is.

The most obvious interpretation of what is printed is, that Mr. Spencer refers to the local value of figures in the Arabic system of notation: this is probably not what is meant.

Two other interpretations suggest themselves. The sum of seven and five is the same number whatever be the things to which the seven and five refer; or else the more particular statement that the sum of seven and five is the same as the sum of ten and two. It is not apparent that either of these is intended.

To say that seven and five make twelve without implying something about twelve other than the statement that it is seven and five, seems a proposition so purely verbal that it is difficult to see how the recognition or non-recognition of it illustrates the grounds of belief in physical laws.

NOT A METAPHYSICIAN

The Glacial Period

IN the many kind and favourable reviews of my book, "The Naturalist in Nicaragua," exception has been generally taken to my speculations on the extent and effects of the ice of the glacial period. The subject is a large one, and too little of my time can be given to scientific inquiry to allow me to hope that I can deal with it in detail for some years to come; but as it appears that I have not expressed my views with sufficient clearness and have been misunderstood by some of my critics, I shall be glad of an opportunity to state them with distinctness and brevity.

1. At the present sea-level, the ice extended, in the northern hemisphere, from the Pole to lat. 39° in America, to about the valley of the Thames in England, to lat. 50° in central Europe, and to lat. 52° in north-western Asia. Along the high lands of America it reached to the tropics, and in Central America all the land lying over 2,000 ft. above the sea supported glaciers. I do not contend that the present low lands of tropical America were ever covered with ice, and it is on the mountain chains of that continent alone that I believe it nearly reached to the equator.

2. The ice was thickest over the American continent, not because it was coldest there, but because the great evaporating area of the Pacific lay to the south-west of it and the counter trade-wind swept across it and precipitated the moisture with which it was laden. Siberia was equally cold, but the upper moisture-bearing currents of air were intercepted by the Himalayas, the Kuen Lun, and the Altai Mountains. It was thickest in America for the same reason that it is thicker on the summits of the Pyrenees than on similar heights on the Caucasus, and thicker on the southern than on the northern slope of the Himalayas, not because of greater cold, but of greater precipitation.

3. The immense accumulation of ice in the extreme north of America and Europe must have overflown and filled the polar basin even if it had not independently collected there; but the precipitated moisture would not have frozen on the continents if the climate had not been much colder then than now; and the surface of the Arctic Ocean must have been frozen over, and as capable of sustaining accumulations of snow as the solid land itself, even if that ocean was not displaced by the ice flowing into it from the northern extremities of the continents.

4. Probably the ice was not thickest at the Pole, but formed a ridge of varying height at unequal distances from it; for, as we have seen, it would not be thickest where it was coldest, but where there was most precipitation, and the south-west winds would part with their moisture long before they reached the Pole.

5. Whilst we can follow on the land the marks left by the ice of the glacial period, and map out its former boundaries, we can only speculate on its extent over the areas now covered by the sea. We have, however, some evidence. The Hebrides and the extreme north-east of Scotland were overflown by ice that came from the north-west, and the bed of the North Atlantic must have been filled so far at least, or to about lat. 59°; and taking into account the much greater quantity of ice lying on America than on Europe, it is not an extreme supposition that on the western side of the Atlantic the bed of the ocean was occupied by ice to lat. 45°.

6. One of the principal effects of this great advance and accumulation of ice, not yet taken into consideration by geologists, was an interruption to the drainage of all countries whose rivers flowed northwards. The great plain of Siberia was, I believe, occupied by an immense lake caused by the blocking up of the whole of the watershed to the north. In western Europe this interference with the drainage of the land took place, even if we do not accept the theory of an ice-cap, but hold with some geologists that the ice descended only from existing chains of mountains. All the rivers of northern Germany must have been dammed back by the ice descending from the Scandinavian mountains. One of the most important changes was effected in the German Ocean. Its northern half was filled with ice, from the mountains of Norway and Sweden, from Scotland and northern England. As we know that at this time the Straits of Dover did not exist, it is evident that the southern portion of the bed of the German Ocean must have been filled by a great fresh-water lake, varying in extent during the advance and retreat of the ice, into which flowed all the water of the melting ice, and all the rivers that now run into the same area.

7. There is no satisfactory evidence of the intercalation of a warm period between two glacial ones, though doubtless there was more than one retreat of the ice, during which a temperate climate prevailed in regions glaciated before and afterwards. The intermingling of the remains of northern and southern mammalia in the gravels of south-eastern England arose, probably, as explained by Sir Charles Lyell, by a northern and a southern fauna having migrated to the district at different seasons of the year.

When the German Ocean was blocked up to the north by ice, a great river must have run to the south through what are now the Straits of Dover and the English Channel, receiving into one stream the waters of the Rhine, the Thames, the Humber, and the Somme. How far that river ran southward would depend upon the relative heights of the land and the sea. It must have run into a comparatively warm ocean, for the effects of the warm currents of water coming from the tropics, instead of as at the present time entering the polar basin, would be confined to and intensified in more southern latitudes, and they would then, as now, be deflected upon the western coast of Europe. Up this river the hippopotamus and the southern species of rhinoceros and elephant may have come in summer and autumn, whilst the mammoth, the woolly rhinoceros, and the musk ox came from the north in winter.

8. The theory of the damming-up of many rivers throws much light on the difficult question of the formation of the high and low level gravels and the loess. The lake occupying the area of the German Ocean must have stood much higher in spring and early summer than it did later on in the year and in winter; and the levels of the lower parts of the rivers running into it must have been affected by its rise and fall. If we can suppose that the hippopotamus only came up the river when it was low in the latter part of summer, or in the autumn, we can understand how its remains are only found in the low-level gravels of the Thames and the Somme; though it is also possible that they may belong to a later and milder period when the ice had retired so far back that the great lake partly drained to the north around Scotland.

9. The glacial period probably existed in both hemispheres at the same time. First, because we can trace the evidence of the existence of ice along the high lands of America into the northern tropics until it nearly inosculates with that coming down

from the south, and there is no difference in the character or appearance of the moraines left on both sides of the equator. Second, because, excepting on the supposition that the ice extended, at least along some meridians, both from the south and the north nearly to the equator, at the same time, we cannot explain the distribution of those animals and plants that are found in the temperate zones of both hemispheres, separated by the whole width of the tropics, over which they cannot now pass. For example, there are more than forty flowering plants of North America and Europe which are also found in Terra del Fuego. Darwin's theory that these plants were driven to the high lands of the tropics during the glacial period, and followed the retreating ice in its retrocession, must fall to the ground if the ice did not exist in both hemispheres at the same time. (See "Origin of Species," p. 405, &c.)

10. The piling-up of water around the poles in the form of ice could not fail to affect the level of the ocean. Mr. Alfred Tylor has calculated that the accumulation of the ice in the northern hemisphere alone would abstract so much water as to lower the level of the sea 600 feet; and if, as I believe, the glacial period occurred at the same time in both hemispheres, the level of the ocean must have been lowered at least 1,000 feet.

11. The theory of the lowering of the level of the sea during the glacial period is directly opposed to the generally accepted one of a great submergence of part of England and Scotland to a depth of about 2,000 feet, when the marine shells of Moel Tryfaen and Macclesfield were deposited. The facts on which this theory of submergence is based can be otherwise explained. The shells are broken or worn, and generally mixed amongst other transported materials. They are just where they ought to be found on the supposition that an immense body of ice coming down from northern Ireland, from Scotland, and from Cumberland and Westmoreland, filled the basin of the Irish sea, scooped out the sand with the shells that had lived and died there, and thrust them far up amongst the Welsh hills that opposed its course southward and around the great bight of which Liverpool forms the apex. Excepting some raised beaches around our coast, which were probably formed after the glacial period, and in no case reach more than 100 feet above the present level, I believe there is no evidence of the submergence of Great Britain either during or since the glacial period. THOMAS BELT

Lakes with two Outfalls

THE subject of double outfalls is of some interest, if only as showing the necessity of accurate observation, and the difficulty of ascertaining the truth in matters apparently of simple fact. In NATURE, vol. ix. p. 485, Mr. W. B. Thelwall brings forward two instances of lakes with double outfalls, and states that he has passed two or three more. Now, as regards that upon the Fille Fjeld, which he describes from personal observation, I beg entirely to call in question his accuracy. I passed the locality during each of the two last summers, and my attention was drawn to the position and nature of the watershed, especially during my visit of last summer, when I had carefully inquired into the asserted existence of a natural double outfall at the Lesjeskaagen Vand. (See NATURE, vol. viii. p. 304; also Colonel Greenwood's and Mr. R. B. Hayward's letters, NATURE, vol. viii. p. 382.)

Mr. W. B. Thelwall says:—"Between Nystuen and Skogstad is a chain of lakes crossing the watershed, the highest of which (not the one marked on the Vei-cart over Norge, I think), sends its waters to the west, past Nystuen to the Sogne Fjord, at Lærdalsoren, and on the east by the Lille Mjosen, and Aadalen to the Tyrifjord, and so past Drammen to the Christiania Fjord. This lake is a small one, and the double outflow is close to the high road."

Now this statement is inaccurate in all the essential details. The division of the waters is *not* between Nystuen and Skogstad, but on the other side of Nystuen between it and Maristuen. The water which passes Nystuen does *not* flow towards the west to the Sogne Fjord, but to the east towards the Lille Mjosen, as I carefully ascertained when I was staying at Nystuen. This is rendered certain, too, by the fact that the land rises to the west of Nystuen, the actual division of the waters being about 100 or 105 feet, by my aneroid barometer, above Nystuen. Moreover, having scrambled up a steep mountain close behind Nystuen, whence the view on a clear day is of the wildest character, I had a bird's-eye view of the whole district in debate, and examined it carefully with a good field-glass, with a view to detecting any evidence of a double outflow. I came to the conclusion that the division of the waters took place in the boggy bottom of the valley to the west of Nystuen, and that it would be impossible to say exactly where it was. To the westward of this boggy place is indeed another lake, of which the waters flow to the Sogne Fjord, but this lake is several miles to the west of Nystuen, and separated from it by dry land, rising 100 feet or more above the levels of the water in the two lakes.

Whether lakes with two outflows exist or not, it is difficult to avoid feeling that Colonel Greenwood was warranted in his former incredulity upon the subject. W. STANLEY JEVONS

Trees Pierced by other Trees

UNDER this heading your correspondents discuss two distinct questions as if they were the same, namely the piercing of the stem of a tree by the head of another, as supposed by Mr. Murphy, and the growth of the *root* of a plant in or on another tree. Nothing can be more common than this last. Wherever soil aggregates the roots of seeds will grow as a matter of course. More than this, trees will strike roots into soil collected in their own forks, as I can show here, or down the rotten wood of their own trunks. A remarkable case of this may be seen in a yew tree in West Tisted churchyard near here. But nothing can be more opposite than the growth of the root and that of the head. The root grows to darkness; the head to the light.

Alresford, May 11 GEORGE GREENWOOD

[This correspondence must now end.—ED.]

The supposed Antipathy of Spiders to Chesnut Wood

SOME years back, while walking in the cloisters of New College, I remember a resident Fellow (since deceased) telling me that spiders were never known to occur in the woodwork of the roof, and attributing their absence to the chesnut timber, of which it was framed.

It has been asserted that this wood, which was formerly supposed to be that of the chesnut, really belongs to *Quercus sessiliflora*, but I do not know if that is still held to be the case.

The roof of Westminster Hall was at one time considered to have been constructed of chesnut; has any such story been heard of in connection with it? R. A. PRYOR

13 Bury Street, S.W.

AN EXPERIMENTAL OBSERVATION ON HAY FEVER*

"THE accompanying brief but most interesting paper was received a day or two ago. Believing that it may bring relief to those who during the coming warm weather may be attacked with hay fever, Prof. Tyndall forwards it, with his compliments, to the editor of NATURE."

From what I have observed (says Prof. Binz) of recent English publications on the subject of hay fever, I am led to suppose that English authorities are inaccurately acquainted with the discovery of Prof. Helmholtz, as far back as 1868, of the existence of uncommon low organisms in the nasal secretions in this complaint, and of the possibility of arresting their action by the local employment of quinine. I therefore purpose to republish the letter in which he originally announced these facts to myself, and to add some further observations on this topic. The letter is as follows†:—

"I have suffered, as well as I can remember, since the year 1847, from the peculiar catarrh called by the English 'hay fever,' the speciality of which consists in its attacking its victims regularly in the hay season (myself between May 20 and the end of June), that it ceases in the cooler weather, but on the other hand quickly reaches a great intensity if the patients expose themselves to heat and sunshine. An extraordinarily violent sneezing then sets in, and a strongly corrosive thin discharge, with which much epithelium is thrown off. This increases, after a few hours, to a painful inflammation of the mucous membrane and of the outside of the nose, and excites fever with severe headache and great depression, if the patient cannot withdraw himself from the heat and the sunshine. In a cool room, however, these symptoms vanish as quickly as they come on, and there then only remains for a few days a lessened discharge and soreness, as if caused by the loss of epithelium. I remark, by the way, that in all my other years I had very little tendency to catarrh or catching cold, while the hay fever has never failed during the twenty-one years of which I have spoken, and has never attacked me earlier or later in the year than the times named. The condition is extremely troublesome, and increases, if one is obliged to be much exposed to the sun, to an excessively severe malady.

---

* By Prof. Binz, of Bonn.

† Cf. Virchow's *Archiv*, vol. xlvi. p. 100.

"The curious dependence of the disease on the season of the year suggested to me the thought that organisms might be the origin of the mischief. In examining the secretions I regularly found, in the last five years, certain vibrio-like bodies in it, which *at other times I could not observe* in my nasal secretion. . . . They are very small, and can only be recognised with the immersion-lens of a very good Hartnack's microscope. It is characteristic of the common isolated single joints that they contain four nuclei in a row, of which two pairs are more closely united. The length of the joints is 0·004 millimetre. Upon the warm objective-stage they move with moderate activity, partly in mere vibration, partly shooting backwards and forwards in the direction of their long axis; in lower temperatures they are very inactive. Occasionally one finds them arranged in rows upon each other, or in branching series. Observed some days in the moist chamber, they vegetated again, and appeared somewhat larger and more conspicuous than immediately after their excretion. It is to be noted that only that kind of secretion contains them which is expelled by violent sneezings; that which drops slowly does not contain any. They stick tenaciously enough in the lower cavities and recesses of the nose.

"When I saw your first notice respecting the poisonous action of quinine upon infusoria, I determined at once to make an experiment with that substance, thinking that these vibrionic bodies, even if they did not cause the whole illness, still could render it much more unpleasant through their movements and the decompositions caused by them. For that reason I made a neutral solution of sulphate of quinine, which did not contain much of the salt (1·800), but still was effective enough, and caused moderate irritation on the mucous membrane of the nose. I then lay flat on my back, keeping my head very low, and poured with a pipette about four cubic centimetres into both nostrils. Then I turned my head about in order to let the liquid flow in all directions.

"The desired effect was obtained immediately, and remained for some hours; I could expose myself to the sun without fits of sneezing and the other disagreeable symptoms coming on. It was sufficient to repeat the treatment three times a day, even under the most unfavourable circumstances, in order to keep myself quite free.[*] There were then no such vibrios in the secretion. If I only go out in the evening, it suffices to inject the quinine once a day, just before going. After continuing this treatment for some days the symptoms disappear completely, but if I leave off they return till towards the end of June.

"My first experiments with quinine date from the summer of 1867; this year (1868) I began at once as soon as the first traces of the illness appeared, and I have thus been able to stop its development completely.

"I have hesitated as yet in publishing the matter, because I have found no other patient[*] on whom I could try the experiment. There is, it seems to me, no doubt considering the extraordinary regularity in the recurrence and course of the illness, that quinine had here a most quick and decided effect. And this again makes my hypothesis very probable, that the vibrios, even if being no specific form but a very frequent one, are at least the cause of the rapid increase of the symptoms in warm air, as heat excites them to lively action."

I should be very glad if the above lines would induce medical men in England—the haunt of hay fever—to test the observation of Helmholtz. To most patients the application with the pipette may be too difficult or impossible; I have therefore already suggested the use of Weber's very simple but effective nose-douche. Also it will be advisable to apply the solution of quinine *tepid*. It can, further, not be repeated often enough that quinine is frequently adulterated, especially with cinchonia, the action of which is much less to be depended upon.

Dr. Frickhöfer, of Schwalbach, has communicated to me a second case in which hay fever was cured by local application of quinine (Cf. Virchow's *Archiv* (1870), vol. li. p. 176). Prof. Busch, of Bonn, authorises me to say that he succeeded in two cases of "catarrhus æstivus" by the same method: a third patient was obliged to abstain from the use of quinine, as it produced an unbearable irritation of the sensible nerves of the nose. In the autumn of 1872 Helmholtz told me that his fever was quite cured, and that in the meantime two other patients had, by his advice, tried this method, and with the same success.

THE COMING TRANSIT OF VENUS[†]

IV.

It has already been pointed out how unsatisfactory in some respects were the results of the observations made in 1761. Those of the year 1769 were more successful, but the discrepancies of different observers still threw a doubt on the result. After Encke had discussed with all possible care the observations made upon these two occasions,[‡] doubts were still raised as to the correctness of the value thus found for the solar parallax. The reasons of these doubts were manifold. In the first place in order to get any value whatever of the solar parallax, Encke had been forced to assume that enormous errors had been committed by some of the observers; and again, all the other methods of which we have spoken were found to give a tolerably accordant value of the solar parallax, but values that differed considerably from Encke's determination.

It was with no small satisfaction then, that astronomers learnt that M. Powalky in 1864 had deduced a sensibly greater value for the solar parallax, by using more accurate values for the longitudes of the places of observation.

But Mr. C. J. Stone, now her Majesty's astronomer at the Cape of Good Hope, has lately re-discussed these observations.[§] He finds that when the remarks of the observers are rightly interpreted, all the observations agree without any extravagant errors of observations; and moreover, the value of the solar parallax thus deduced agrees with the values found by other means. Mr. Stone deserves the thanks of the scientific world for having convinced them that this method, which at one time was falling into disrepute, may really be rendered very trustworthy.

The result of Encke's determination was that the mean distance of the sun from the earth is about 95 millions of miles. It now appears that the true distance is somewhere about 91½ millions of miles. The annexed table gives the values of the sun's parallax and distance as determined by different methods.

---

[*] There is no foundation for the objection that syringing the nose could not cure the asthma which accompanies hay fever, for this asthma is only the reflex effect arising from the irritation of the nose.—*B.*

[*] Helmholtz, now Professor of Physics at the University of Berlin, is although M.D., no medical practitioner.—*B.*

[†] Continued from p. 14.

[‡] *Berlin Abhandlungen*, 1835, pp 235-310.

[§] Monthly Notices of the R.A.S., xxviii, p. 155.

Method.	Parallax.	Dist. of sun in miles	Computer.
Transit of Venus * . .	8″·91	91,580,000	Stone
Opposition of Mars † .	8″·943	91,240,000	Stone
Lunar Theory ‡ . . .	8″·916	91,520,000	Hansen
Lunar Theory § . . .	8″·850	92,200,000	Stone
Planetary Theory ‖ . .	8″·859	92,110,000	Leverrier
Jupiter's Satellites and velocity of light ¶ .	8″·86	92,100,000	Foucault
Constant of Aberration and velocity of light **	8″·86	92,100,000	Cornu

The uncertainty of observation which Mr. Stone aimed at clearing away is one of a very curious optical character. It is found that Venus at the time when she has almost completely entered within the sun's disc does not retain her round aspect, but becomes pear-shaped, or at least connected with the sun's limb by a "black drop" or "ligament." This ligament sometimes appears simply as a fine black thread connecting the planet with the limb of the sun. One observer in 1769 saw a number of black cones shooting out to the sun's edge in a fluctuating manner.

Many of these phenomena were doubtless due to bad definition of the telescope employed, or to the instability of its mounting. But the existence of a "black drop" even under the most favourable circumstances cannot be doubted; it was well observed in the case of a transit of Mercury that occurred in 1868.†† If the planet be entering upon the solar disc, the first phase occurs when the edges of the sun and planet *seem* to be in contact. The second phase occurs at the instant when the "black drop" breaks off and a flood of light sweeps in between the planet and the sun. This occurs very suddenly, and has been supposed to indicate the true time of actual contact.

By referring to the *Philosophical Transactions* of 1769-70, a large number of descriptions of the phenomenon may be read. Some of the appearances are shown in Fig. 14, they are copied from the originals by Bevis, Hirst, Bayley, and Mayer, respectively—Prof. Grant states that the last one bears a resemblance to the appearance of Mercury as seen during its transit in 1868 from the Glasgow Observatory, the sun being near the horizon.

In the case of that transit of Mercury, studied by six experienced observers at Greenwich Observatory, two curious facts appear. Firstly, the times of contact as determined by different observers vary to the extent of 13½ seconds. And secondly, the shape of the planet varied considerably with different observers.

Mr. Stone having noticed a confusion in the language of the astronomers of the last century as to which of the two phases was observed, carefully re-studied their words; and by supposing the two phases to be separated by a constant interval of time, he utilised both kinds of observation. This constant interval of time was deduced from all the observations, and found to be about 17 seconds. In this manner he arrived at the more accurate value of the sun's parallax.

It has been asserted that astronomers claim undue credit for the accuracy of their measurements, since Encke made an error of three or four millions of miles in the calculation of the sun's distance. This is not so. A chemist may be able to weigh many substances with an error of $\frac{1}{100}$ per cent. or less; but if the substance to be weighed be only $\frac{1}{100}$ of a milligramme, he might have a larger percentage error. When we consider how extremely small an angle the solar parallax is, it is astonishing to find so great a concordance between the results of different methods.

As to the cause of the phenomenon of the "black drop," Lalande ascribed it to irradiation. Irradiation is that curious phenomenon in virtue of which a star, or any bright object, appears larger than it really is. If a thin platinum wire be intensely heated by the passage of an electric current, it seems, to a person distant about fifty feet, to be as thick as a pencil. In this way the sun's diameter seems to be increased. The sun's light also encroaches upon the disc of the planet and makes it seem to be smaller than it really is. But when Venus and the sun have their edges almost in contact, as shown by the dotted line in Fig. 15, then there is no light at that point which can encroach; hence we see at this point the "black drop" to which allusion has been made.

Father Hell, one of the observers in 1769, ascribed the phenomenon of the "black drop" to the sensible size which an illuminated surface must have before it can be visible. There is probably some truth in each of these suppositions.

As to the cause of irradiation, it is difficult to speak with certainty. It is probably caused in part by the telescope and in part by the eye. Great confusion has been introduced by persons neglecting to separate two perfectly distinct phenomena. True irradiation is only observed with a powerful light. With less illumination similar results may be seen, but they are of a different nature, and are produced between the formation of an image on the retina and its reception by the brain. In accordance with the customary nomenclature, this error of vision may be called the *mental aberration* of the eye. It is a perfectly definite phenomenon capable of accurate investigation, and M. Plateau has made measurements of the mental aberration of his own and his friends' eyes.* True irradiation may be caused either wholly or in part, by the spherical aberration or the chromatic aberration of the eye, or by diffraction, or by a spreading of the excitement of the nerves of the retina, which gives rise to the sensation of vision over a sensible space. In a telescope it is probably chiefly due to diffraction.

The success or failure of all observations of contact in the coming transit will to a great extent depend upon our knowledge of the nature of this appearance. For this reason numerous experiments have been made with the object of gaining information upon the question. The Russians, Germans, Americans, and English have all mounted artificial transits of Venus for the practice of observers. The arrangement adopted by the Astronomer Royal consists essentially of a metal disc with two arcs of circles drawn upon it to represent the sun's edge with the metal between them cut away. Behind these there passes a glass plate with a circle of metal to represent Venus let into it flush with its surface. The glass plate is moved by clock-work so that the different phenomena are observed in succession exactly as they will be seen in the true transit. As the artificial planet passes in succession the two arcs representing the sun's edge, the phenomena of ingress and egress are successively observed. Before contact takes place, the sun has two cusps at the point of contact where Venus is touching the edge of the sun. The distance between the points of these cusps rapidly diminishes, the space between them being intensely black. They suddenly meet. But between the planet and the sun's edge a light shade is still seen which lasts several seconds before the planet appears completely detached. If instead of watching the meeting of the cusps, the part between them be studied, a sudden diminution of intensity of the blackness is seen about a second before the meeting of the cusps. The diminution of brightness is very sudden, and this is the phenomenon to be chiefly attended to in the actual observation. It occurs almost exactly at the moment of true contact, though the "black drop" does not disappear until some seconds later. It is of the utmost importance that the nature of these different phenomena should be carefully studied by all the observers. And at the present time experiments are being made with a view of determining the personal equation of each of the observers on the British expeditions.

---

* Monthly Notices, xxviii., 255.

† *Ibid* xxiii., 183.

‡ *Ibid.* xxiv., 8.

§ *Ibid* xxvii., 271.

‖ *Comptes Rendus*, July 22, 1872.

¶ *Ibid.* 1862, p. 502.

** *Ibid*, 1873, p. 341.

†† Monthly Notices, xxix., p. 17, &c.

* Nouv. Mém. de l'Acad. Royale de Bruxelles, t. xi. p. 1, &c.

But the actual observation will be rendered more difficult for various reasons. Firstly, the enormous extent of atmosphere which the rays of light must penetrate before reaching the telescope will destroy the definition to a large extent. Secondly, the existence of an atmosphere around the planet Venus may materially affect the nature of the phenomenon.

In any case there is little doubt that as many of the observers as possible of all countries should describe, as accurately as can be done, the exact appearances which are noticed at successive stages of the ingress and egress respectively. Comparisons being also made between different observers and between different telescopes, it will be possible to reduce the observation of any phase which may chance to be caught in the actual observation to the true time of contact. From observations with the Model Transit of Venus made at Greenwich, the following facts appear :—

1. It requires considerable experience for an observer to appreciate all the definite changes of appearance which occur.

2. When two observers describe a particular phase which they see, and determine to observe this phase together, the times recorded by each are generally accordant within a fraction of a second.

3. The successive phases of an ingress or egress appear to follow each other sometimes rapidly, at other times gradually; so that in some cases all the phenomena are observed within three seconds, on other occasions the same series of phases is completed in ten seconds.

4. The time at which any particular phase is observed varies very slightly with the aperture of the telescope. When a telescope of good definition is employed, the time of any phase at ingress is earlier than with an instrument of less perfect definition.

In the case of the observations of last century, it is easy to see how observers quite unprepared by previous observations as to the nature of the appearances they were about to witness were sometimes inconsistent with each other. In fact, without preliminary practice, and with bad definition, observers might vary even with a Model Transit of Venus by as much as 15 seconds. But, knowing what they are to observe, they would differ under no circumstances by more than about 2 seconds. Hence it is probable that in the actual transit, if the definition be good, the observation *may* be accurate to within one second; but if the circumstances be not very favourable, they may differ to an extent of fully three seconds, even after considerable practice with the model. These estimates serve to give us some idea of the accuracy with which we may hope to have the observations made; and it is probable, from the care which has been taken to multiply the number of observers at each station, that each pair of observations of contact will give us a determination of the parallax of the sun true to about $\frac{1}{4}$ per cent.

In the observations of contact, however, a great deal depends upon the experience of the observer; and it is fortunate that the idea originally thrown out by M. Janssen, and the mechanical execution of which has since been so ably carried out, will indelibly record the progress of the phenomenon and serve as a check to the observers.

By the aid of this method photographs of particular sun-spots have already been taken with great success at intervals of one second during one minute of time. Each of these sixty photographs is perfect in itself, and would admit of very perfect measurements. Hence there is every reason to believe that in this manner an independent and very valuable observation of the true time of contact will be made at each stationwhere a photo-heliograph is situated.

The observations by means of photography during the progress of the transit have few difficulties to contend with. Their value will be largely increased by the fact that the actual measurements will be made afterwards when the observer cannot be carried away by the excitement of the moment. But even in this class of observation there are difficulties which must be carefully considered. It is found that if a sensitised plate be over-exposed, the image of the sun is considerably enlarged. This is due to *photographic irradiation*. It has been found by Lord Lindsay and Mr. A. C. Ranyard to be mainly due to the reflection of light from the back of the glass plate.[*] It can be almost entirely avoided by wetting the back of the plate, and placing black paper against it. There will still be probably a slight enlargement of the sun's diameter. This will not affect the relative positions of the centres of the sun and Venus; but it will render it extremely difficult to determine the unit of measurement.

There are two ways of applying the photographic method. The first is the same as the heliometric method. For this purpose it is necessary to have one station in the north and another in the south. By the other method we do not determine the least distance between the sun and planet, but the actual position of the planet at each observation. In other words, we determine the distance of Venus's centre from the sun's centre, and also the angular distance measured from the north point of the sun. To do this we must have in the focus of the photo-heliograph a fine thread to indicate the direction of the meridian in the photograph; or in the American method we must have a thread suspended vertically which shall indicate the vertical direction in the solar photograph. The arrangements of the American method, as set up by Lord Lindsay at Dunn Echt, are shown in Fig. 16. The siderostat, lens, and hut, are all shown in position.

The value of the different methods has been well discussed by De La Rue,[†] Tennant,[‡] and Proctor.[§] The method which takes into account the *actual* position of the planet on the sun is the more accurate, but it requires that the fiducial lines, or lines of reference, shall be exactly represented in the photographs. Mr. De La Rue says that this can be done to within one minute of space.

Besides photographic irradiation, however, there is a very important difficulty which enters into both the photographic and heliometric methods. This is due to the refraction of our atmosphere. Everyone knows the distorted forms which the sun assumes at the time of sunset. In our own climate these appearances are seldom seen on account of clouds and the haziness of the atmosphere. But even from a high mountain, or from any position which allows the form of the sun to be accurately seen up to the time of sunset, its shape may be noticed to be either square, elliptical, or pear-shaped, according to the circumstances of the atmosphere. Now at the most favourable points of observation the sun will be comparatively near to the horizon. Consequently its form will vary with the temperature of the air and with atmospheric disturbances. With our feeble knowledge of the laws of refraction it will be a matter of some difficulty to determine with accuracy the distance at different times between the centres of the sun and Venus.

[*] Monthly Notices of the R.A.S. 1872, p. 313.

[†] *Ibid.* xxiv., 48 and 282

[‡] *Ibid.* 282

[§] *Ibid.* xxx., 62.

The same remarks apply to the heliometric method. But with stations chosen where the sun is not too low, we may expect accurate results. The value of a heliometer over other instruments designed for measuring small angles consists in this, that by it we can measure angles as large as the sun's diameter. It is expected by observers with this method that an observation will be made each time with an accuracy comparable with that of an observation of the time of contact. In this case the heliometric method will give valuable results. For the same reasons observations made by means of a double-image micrometer of the distance between the limbs of the sun and Venus near the time of contact will be as accurate as an observation of the contact itself.

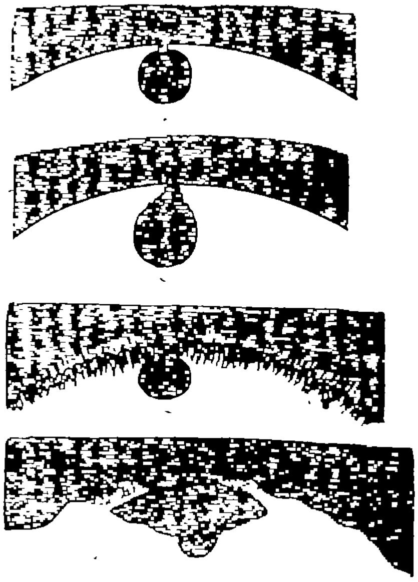


FIG. 14.—The "black drop" as observed in 1769.

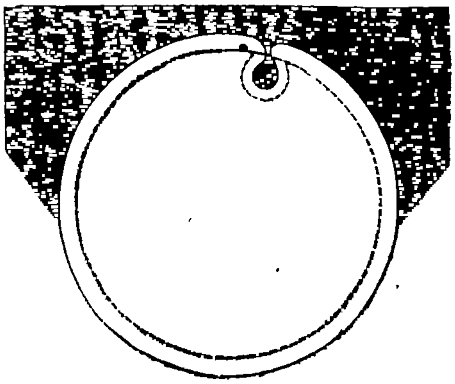


FIG. 15.

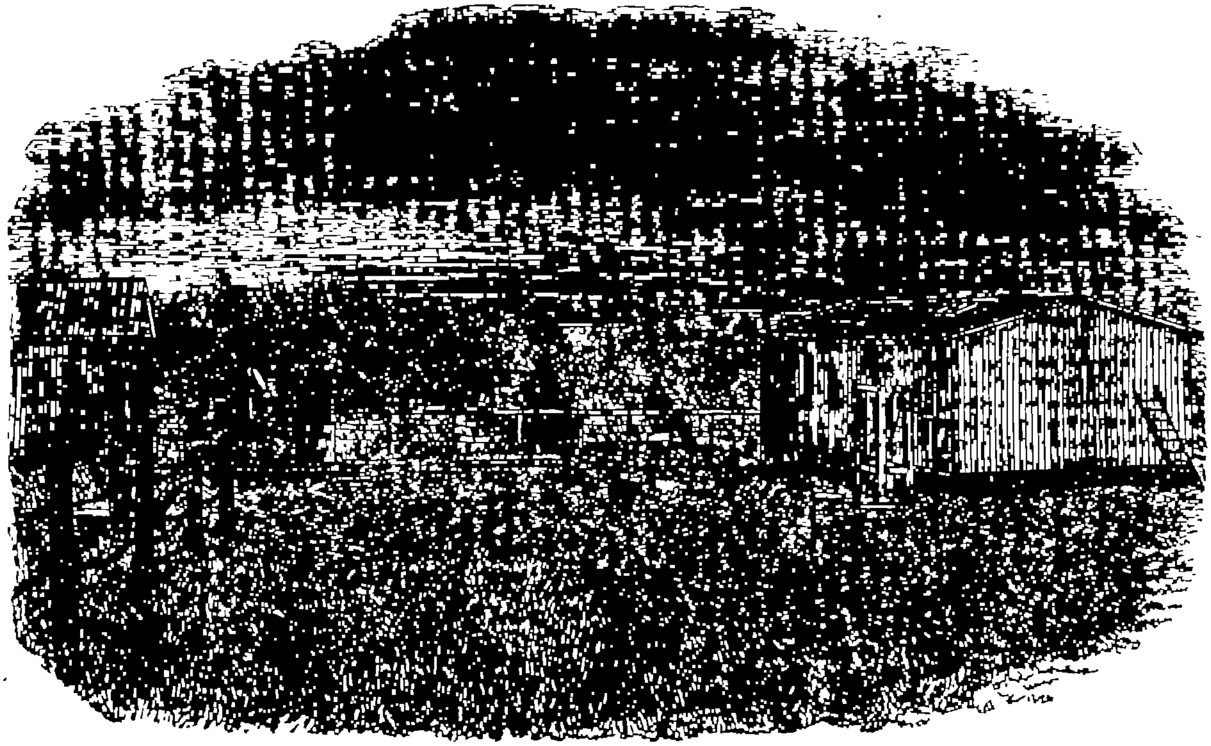


FIG. 16.—Lord Lindsay's Photographic Arrangements as set up at Dunn Echt

The last difficulty which we shall mention in connection with this kind of observation is due to atmospheric conditions as affecting the apparent time of contact. With regard to the British expedition, great care has been taken to choose stations where the weather can be depended upon. But in cases where the method of duration is applied, the observations will be useless if there be not a very clear atmosphere both at ingress and at egress. De l'Isle's method, on the other hand, requires a perfect observation only at the time of one of these phases. Hence the nations which have adopted this method are less likely to be disappointed than others.

GEORGE FORBES

(*To be continued.*)

LARVÆ OF MEMBRACIS SERVING AS MILK-CATTLE TO A BRAZILIAN SPECIES OF BEE

MY letter in NATURE, vol. viii. p. 201, was incomplete so far as the names of the Brazilian insects alluded to are concerned, but I am now enabled accurately to name both the supposed milk-cow and the supposed milker. With regard to the former, Mr. Rogenhofer, of Vienna, has had the kindness to compare my specimens of Membracis with the collection in the museum of that metropolis, and informs me that my Membracis belongs to the genus *Potnia* of Stal (*Umbonia* of Fairmaire), the species most probably being *indicator* Fairm. As to the Trigona species referred to in the above letter, I have in the meantime received numerous good specimens, not only a number of workers, but also some males, and even one queen. Mr. Frederick Smith has been good enough to compare my specimens with the collection in the British Museum, and has found that they belong to an undescribed species. Having worked through the literature on Trigona and Melipona as completely as possible, and after perusing the descriptions of about one hundred species, not having found a single one of which all three kinds of individuals are known, I think it will be welcome to the readers of this journal, who are interested in entomology, if I do not restrict myself to merely mentioning the name and diagnostics of my new Trigona species, but give a description of its workers, male and queen, adding a brief account of its peculiar habits and economy from my brother's (Fritz Müller) observations.

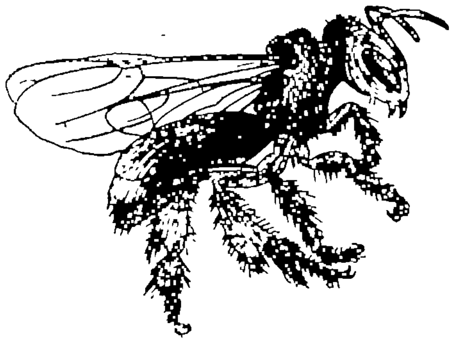


FIG 1.—Cacafogo, worker (side view).

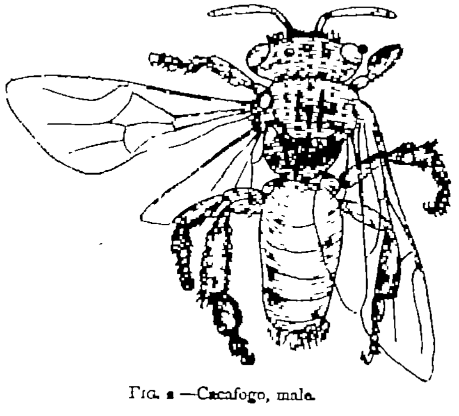


FIG. 2.—Cacafogo, male.

*Trigona cagafogo**

Length of the workers and males 5—5½, of the queen 6—7 mm. Males and workers are almost alike in size, colour, and outline of the body, and are distinguished from most other species of the same genus by the breadth of their head and the narrowness of their abdomen, which, in the workers, scarcely exceeds half the breadth of the head. In the males the abdomen is equally slender, but the head somewhat less broad; in the queen the head is of the same size and form as in the workers, but the abdomen is so much dilated as to reach one and a half times the breadth of the head.

The head, tegulæ, scutellum, and abdomen, in all three kinds of individuals, are ferruginous, smooth and shining, the posterior margins of the vertex, of the scutellum and of the last segments of the abdomen have a black pubescence; the rest of the thorax, together with the legs, is black with black pubescence; the antennæ black, the greatest part (☿) or the whole (♂) of the scape rufo-piceous, the flagellum fuscous beneath. The wings by far exceed the abdomen; the basal portion and radical cell of the anterior wings dark fuscous; their apical portion and the posterior wings subhyaline; the stronger nervures brown, the feeblest ones pale ferruginous; no cubital cell at all. The mandibles with two teeth at their apex. The tibiæ triangular, their outside pubescent from the base to the middle, towards the apex slightly excavated, smooth, shining, and naked. The whole body destitute of feather-like hairs. The unguiculæ of the males are, in this as in other Trigona and Melipona species, two-cleft; whilst those of the workers and females are simple. The queen, besides her larger size and the much dilated abdomen, differs from the workers by the colour of the head being somewhat paler, the antennæ longer, the thorax stronger, its anterior and lateral margins and two longitudinal streaks rufo fuscous, the anterior wings provided with a completely closed cubital cell, the legs larger and more robust, especially the anterior and middle tibiæ much thicker, the outside of the posterior tibiæ slightly convex and pubescent nearly

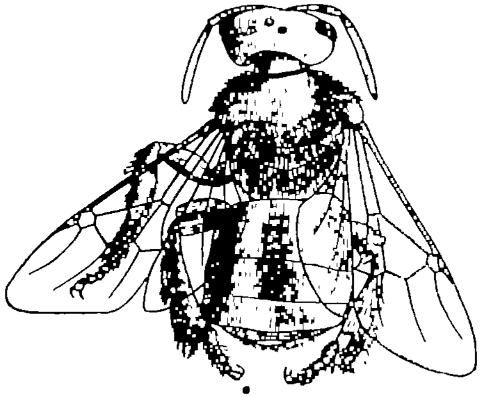


FIG. 3.—Cacafogo, queen.

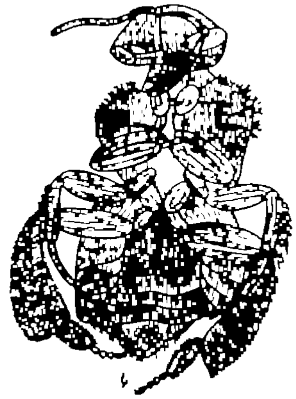


FIG. 4.—Cacafogo, queen (from beneath)

---

* I call the species Cagafogo, using the vernacular name for the specific one.

as far as the apex, the apex of the posterior tibiæ bordered with partly feather-like hairs.[*]

The nests of *T. cagafogo*, like those of many other species, are built in hollow trees. One of two nests which my brother had the opportunity of observing was found in a tree cut down a long time before; but its combs, lying in confusion, probably in consequence of the direction of the trunk having been altered by felling the tree, showed that the nest had probably been built before the tree was felled. In this nest, the inhabitants of which partly perished by having been plastered over with the honey which flowed from the damaged honey-pots during the transport, partly, as is to be supposed, flew away afterwards; besides a great number of workers and a small number of males, only a single queen was found, viz. that illustrated in Figs. 3 and 4. The honey-pots, of the size of large hazel-nuts, were closely aggregated together. The honey was of a very viscous consistence, partly as clear as water, partly lighter or darker yellow; its flavour appeared to my brother insipid, pituitous, and somewhat disagreeable (the latter perhaps, as he supposes himself, because he was conscious of the cagafogos feeding upon carrion). The brood-combs, as with other Trigonas, were simple layers of hexagonal upright cells. The wax, of which both the honey-pots and the brood-combs were built, was nearly of a pure white colour, but it was mixed with such an enormous quantity of heterogeneous ingredients (perhaps 90 per cent.) that the building appeared of a dirty brown or blackish colour.

Another nest, found by my brother in a trunk of *Canella pimenta*, about five meters above the ground, was brought safety home after cutting down the tree; but a week afterwards all the inhabitants had flown away.

The most striking feature in the natural history of this stingless bee is its fondness for oily matters, and its singular means of defence, connected with a great irritability. As I have already stated (vol. viii. p. 201) it feeds upon carrion; and is also fond of old stinking cheese. When visiting flowers, it seems to be also guided by its particular taste; it visits in swarms the flowers of a bean with glandular calyx; also a white-flowered Abutilon and *Sicyos angulata*, the flowers of which are glandular and secrete an oil. It was also observed fertilising the flowers of *Asclepias curassavica*, milking the larvæ of Membracis, repeatedly sucking the juice flowing out of trees, and devouring the sugar spread to be dried. Its singular means of defence are indicated by the vernacular name Cagafogo (spit-fire), for although stingless, like all other Trigonas and Meliponas, it possesses a very intense venom, which causes a most lively irritation in the skin. Whilst the defenceless species are for the most part very peaceable, the Cagafogos, on the contrary, are so irritable that the observation of their nests proves impossible, unless cold weather or strong breezes from the land keep them quiet.

Lippstadt HERMANN MULLER

THE MAMMALS OF MOUPIN

"WHERE is Moupin?" our readers will say, when they see the heading of this article. To this it may be replied that, if not already well known to zoologists, Moupin bids fair to become so very quickly, as it possesses one of the most strange and interesting faunas which have become known to us of late years. Moupin is the name of one of the small independent principalities lying on the extreme west of the great Chinese province of Setchuan. It does not appear to be marked on any of our charts, but if our readers will turn to the map of China and find Ching-tou, the capital of Setchuan, they will see still farther to the west a range of mountains designated the "Yungling Mountains," which separate China proper from Thibet. Amongst these the district called Moupin is situated.

The first and only European who has penetrated to this remote corner of the earth is the celebrated French traveller, Armand David, a missionary priest of the congregation of Lazarists, who has for many years, by permission of his superiors, devoted himself to the exploration of the Chinese flora and fauna. Père David left his mission in Pekin in May 1868, and travelled by the Yangze-kiang—the great high road into the interior of China—to Chong-kin. Hence he proceeded by land, leaving his baggage to follow by water, and after twelve days' journey reached Chong-tong, the capital of the great province of Setchuan, where there is a large Catholic mission, presided over by an Apostolic vicar. Hence to Moupin was eight days' journey farther westward, during the latter portion of which a mountain range nearly 10,000 ft. high was traversed. Père David's ordinary residence in Moupin was in one of the high valleys at an elevation of about 7,000 ft. above the sea-level, above which rose one of the principal mountains of the district to the height of 15,000 ft. Up to about 10,000 ft. dense woods of pines and cedars varied with rhododendrons, laurels, and magnolias prevail. During a ten months' residence in this locality, Père David formed extensive collections in every branch of Natural History, which were transmitted to the museum of the Jardin des Plantes at Paris. In a report[*] addressed to the professors of that establishment, which has been lately published in the 7th volume of the "Nouvelles Archives," Père David has given a complete list of the mammals of his collection, which embraces no less than 110 species. The novelties are shortly described by M. Alphonse Milne-Edwards, one of the naturalists of the Jardin des Plantes, who, however, is now giving a much more complete account of them in a large work on which he is engaged, entitled "Récherches sur l'histoire naturelle des mammifères." The following are some of Père David's most remarkable discoveries in Moupin in the class of Mammals.

Under the name *Rhinopithecus roxellanæ* is described a very singular new form of monkey, clothed with dense hair, and with a turned-up nose, which inhabits the highest forests adjoining the snow. A second monkey from the same mountains is described as *Macacus thibetanus*; and a third was ascertained to exist in the rocks of the more eastern part of the district, but was, unfortunately, not obtained.

Amongst the Insectivora, Père David's discoveries are also remarkable. Besides several species of shrew, of the known genera *Sorex* and *Crocidura*, a new form, allied to *Diplomesodon*, was discovered, which M. Milne-Edwards names *Anourosorex squamipes*. Still more curious is an entirely new aquatic form, allied to *Mygale*, which M. Milne-Edwards names *Nectogale elegans*. The moles are also represented in Moupin by two entirely new genera, *Uropsilus* and *Scaptonyx*, besides a new species of true *Talpa*.

The rodents of Moupin embrace several new species of *Mus*, *Rhizomys*, *Siphneus*, and *Lagomys*, besides squirrels of different genera: examples of thirty-six species in all were obtained. The carnivores also furnished some important novelties, three new polecats (*Putorius*), two new species of the badger-like form *Arctonyx*, and a new cat (*Felis*). But in this group the most industrious discovery was that of the *Ælurus fulgens*—hitherto regarded as a type peculiar for the higher Himalayas, and of its allied but larger brother *Æluropus melanoleucus*—one of the most wonderful of recent additions to the class of mammals. These two genera constitute a special family of carnivores, representing, in the Palæarctic region, the

---

[*] A more full and detailed description of this and some other new species will be given in a separate treatise on Trigona and Melipona, to be published by my brother and myself.

[*] Rapport addressé à MM. les Professeurs-Administrateurs du Muséum d'Histoire naturelle par M. l'Abbé Armand David. Nouv. Arch. d Mus. vii. Bull. p. 75.

Procyonidæ of the New World. The *Ælurops* is a large bear-like animal clad in snow-white fur. It inhabits the highest forests, and is called by the Chinese hunters "*Pae-shioung*" or "white bear." Its food is said to be of a vegetable character.

Proceeding to the Ungulates, we find other very remarkable discoveries recorded. The singular form *Budorcas*, hitherto only known from the Mishmee Hills of Assam, a large antilopine-looking creature with a pair of in-curved horns, is also met with in Moupin. Three new *Nemorhedi*, or goat-like antelopes, are also in the list. But perhaps the most interesting of all Père David's discoveries in this order of mammals is a new form belonging to the family *Cervidæ*, which M. Milne-Edwards has termed *Elaphodus cephalophus*. It is intermediate between the muntjacks and the true deer, having the highly developed upper canines of the former, but possessing a minute pair of horns about an inch in length, covered by a long tuft of frontal hairs as in the antelopes of the genus *Cephalophus*.

Altogether, out of the 110 species of mammals obtained by Père David in Moupin, no less than forty turned out to be new to Science, amongst which, as will be seen from what we have said above, were many of the most remarkable characters. There can be little question therefore, we think, that Moupin presents one of the most extraordinary faunas as regards its mammals that has become known to us for many years. It must be conceded that the land is difficult of access, and that perhaps no living European, except Père David, clad in Chinese garments, and speaking the ordinary vernacular of the country, could have found his way there. It has been lately stated in a scientific periodical that zoology is at a discount in France, and that their recent contributions to this science have been of the most meagre description. The splendid discoveries of Père David, and the works of Alphonse Milne-Edwards in which they are described, are of themselves sufficient to refute such a baseless charge.

THE TRANSIT EXPEDITIONS TO RODRIGUEZ AND KERGUELEN'S LAND

SOME four years ago (NATURE, vol. i. p. 527), we directed attention to the desirable opportunity, presented by the Transit expeditions to several little-known spots in the Pacific, of sending out qualified Natural-History observers to the same islands, in order to obtain a knowledge of their flora and fauna. The astronomical stations selected as being especially worthy of this kind of research were the Sandwich Islands, Kerguelen's Land, and the Island of Rodriguez. This subject having been brought before the Council of the Royal Society last year, and thus to the notice of the Treasury, we are glad to be able to announce that, after certain little difficulties on account of the change of Government, the present ministry were induced to grant a sum of money sufficient to send out naturalists to two of these stations, and that arrangements are now being made for their speedy departure along with their astronomical brethren.

Three naturalists will proceed to Rodriguez, the most remote and least known of the Mascarene group of islands. Dr. T. B. Balfour, son of the well-known Professor of Botany of the University of Edinburgh, will devote himself to an examination of the general geological structure of this island, which presents features of the greatest interest, inasmuch as it forms one of the few exceptions to the general rule that all oceanic islands of the deep sea are of volcanic origin. Dr. Balfour will also collect the plants of Rodriguez so as to increase our acquaintance with the flora of the island, which has hitherto, we believe, been scarcely touched.

Mr. George Gulliver, of the University of Oxford, has undertaken the zoological department, and will form as complete a series as possible of the recent animals of the island of every kind. The fauna of Rodriguez, as is well known, is excessively meagre, but it is very desirable that what little endemic life there is left on it should be investigated and collected at once, as being the relics of a very peculiar phase of life which is now passing away very rapidly.

To Mr. Henry H. Slater, of the University of Cambridge, who has had good experience of cave-digging in the north of England, has been entrusted the task of the complete exploration of the limestone caverns of Rodriguez, which has been so ably commenced by Mr. Edward Newton, the Colonial Secretary of Mauritius, with successful results well known to the majority of our readers. We trust also that Mr. Edward Newton may himself be able to accompany the party to Rodriguez, in order to give them the benefit of his advice and assistance. If this can be arranged, there remains no doubt that the Rodriguez expedition will attain most successful results.

For the expedition to Kerguelen's Land, the second point to which it has been agreed that natural history investigaton shall be directed, one naturalist has been considered to be sufficient, regard being had to the well-known poverty of its flora and fauna, and to the fact that the *Challenger* expedition has paid, or will shortly pay, a visit to the island. For this post the Committee of the Royal Society has selected the Rev. A. E. Eaton, who has already distinguished himself by making excellent collections, both zoological and botanical, in Spitzbergen. Spitzbergen, as observed by Dr. Hooker, lies under somewhat similar conditions as regards climate in the northern hemisphere, to Kerguelen's Land in the southern, and there can be no doubt that a naturalist who has worked well in the former will have gained experience likely to assist him in the latter locality.

As regards the exact time of the departure of these two expeditions, we believe that nothing is yet finally settled; but it is probable that the naturalists will in each case depart in company with the astronomers, who are under orders to leave England in the course of the ensuing month.

NOTES

AT a meeting of Convocation of the University of London held on Tuesday evening last, a motion "That in the opinion of Convocation it is desirable that women should be permitted to take degrees in the University of London," was carried by a majority of 83 against 65. The subject will, it is said, shortly be brought before the Senate, with whom originates all fresh legislation, Convocation having only a power of veto.

AT the same meeting a motion urging the Senate not to permit the practice of vivisection to be carried on in the physiological laboratory of the Brown Institution under any circumstances except for medical or curative purposes, was lost by a majority of 59 against 16.

WE have, on more than one occasion, spoken of the disgraceful way in which the Natural History Collections belonging to the defunct East India Company have been treated. They have been "boxed up" several years and deposited in the cellars of the India Office, so that they cannot be got at even when access to a particular type-specimen is requisite to enable a naturalist to determine a *vexata quæstio*. On the 5th inst. Sir John Lubbock endeavoured to ascertain from the Under-Secretary for India whether there is any prospect of the grievance being remedied, but did not succeed in getting much more than the cautious reply that the subject was "under consideration." We believe, however, that there is really a negociation for the transfer of the whole of the collection to South Kensington, in accordance with the suggestion put forward in our article on this subject in NATURE, vol. vii. p. 457, and are glad to recognise that the present Government show some symptoms of paying attention to the just claims of scientific men.

THE Senate of the University of Cambridge last week conferred a great boon on students of Natural Science who intend going to the University, by deciding to accept the certificate of the Leaving Schools Examination in lieu of the Previous Examination. The student who obtains this certificate, passing the examination with distinction, will be able to enter uninterruptedly upon the pursuits of Natural Science as soon as he goes up to the University, and will therefore be able to attain greater proficiency than has hitherto been the case. The examination is, we believe, likely to be a very thorough one, but the particulars can be obtained through the "Regulations of the Oxford and Cambridge Schools Examination Board," which may be obtained for a shilling at any bookseller's.

TRINITY COLLEGE, Cambridge, offers one or more foundation scholarships of the value of 100*l.* per annum. The examination will be open to all undergraduates of Cambridge who have passed the Previous Examination. Also an exhibition of the value of 50*l.* per annum. This examination to be open to all persons under 20 who have not commenced residence at the University. The examination will commence on March 30, 1875. Candidates must send certificates of age and moral character to one of the Tutors of Trinity before March 13.

THE use of a lecture-room in the New Museums, Cambridge, has been granted to Dr. Carpenter for the purpose of giving a lecture on some of the results of the voyage of the *Challenger.*

THE visit of the *Challenger* to Melbourne has been exceedingly pleasant. Free passes have been granted by the railway companies in the most liberal fashion, and excursions have been the order of the day. Letters will reach the *Challenger* if directed to Sydney, by the mails leaving London *via* Brindisi, May 15, *via* San Francisco, June 3. They will find the ship at Somerset, Cape York, on August 16. Letters to Singapore should be sent *via* Southampton, June 18, and July 16; *via* Brindisi, June 26, and July 24.

THE Council of the Society of Arts has fixed Wednesday, May 20, for a general meeting on the subject of Public Museums and Galleries. To it will be invited the Mayors of Corporations, Chairmen of Art and Science Schools, and others interested in the question. The object of the meeting will be to name a deputation to wait upon the Prime Minister, and urge upon him the importance of bringing all National Museums and Galleries under the authority of a Minister of the Crown, with direct responsibility to Parliament; and also of causing all such museums to be made conducive to the advancement of education and technical instruction. The chair will be taken by the Right Hon. Lord Hampton, at 12 o'clock.

THE annual meeting of the Iron and Steel Institute was held on the 6th, 7th, and 8th inst., under the presidency of Mr. J. Lowthian Bell, M.P. The president's address as well as the papers read were almost entirely of a technical nature. The Bessemer medal founded by Mr. Bessemer since the last meeting of the Institute, was awarded to Mr. Lowthian Bell. According to the Report of the Council, the number of members was 644, showing an increase of 122 since the last annual meeting. In Friday's sitting Mr. G. W. Maynard read a paper On the iron ores of the Lake Champlain region. The author gave a topographical and geographical description of the district, and placed before the meeting a large amount of information respecting the minerals existing throughout the whole of the United States.

WE regret to learn the death of Dr. Meissner, the eminent botanist, which took place on the 2nd inst. at Bâle, in the 64th year of his age, "après de longues souffrances." He was a foreign member of the Linnean Society.

MR. EDWARD BARTLETT has been appointed Curator of the Maidstone Museum, which contains so many objects of interest collected by the late Mr. Julius Brenchley in his numerous and extended travels.

IN reply to a question on Monday in the House of Commons Mr. Disraeli said that the claims of the late Dr. Livingstone' family "will be considered by her Majesty's Government, and, if they think they ought to be provided for, we shall not hesitate to ask the House to grant such a vote as they think would be proper under the circumstances." The ways of "her Majesty's Government" are mysterious. Chumah and Susi, Dr. Livingstone's two faithful servants, are expected to arrive at Southampton in the next homeward-bound Indian mail steamer.

THE Rev. Charles New has just left England for the scene of his former labours in Eastern Africa. After investigating some of the less-known portions of the coast he purposes to press forward into the interior in the direction of the sources of the Nile.

A sharp frost set in in many parts of France on May 4-6, and destroyed a quantity of young plants, especially in vineyards. The occurrence had been predicted by M. Sainte Claire-Deville, who is now in Algeria for the purpose of organising meteorological observations in the remotest French desert stations. The disasters are serious, although they do not endanger the future crops and vintage. Several agricultural papers propose to protect young plants against cold spring nights by covering them with canvas or burning substances which produce much smoke, in order to create artificial clouds over the fields. It remains to be seen with what success such schemes, which appear rather rash, may be followed.

WE have received a few additional letters on the destruction of flowers by birds, which we have forwarded to Mr. Darwin.

AT a meeting of the Alpine Club on the 5th inst., Mr. W. S. Watts spoke of a proposed exploration of the Vatna Jokull, Iceland. An exploration devoted to this purpose would, he observed, possess peculiar interest, since the vast area known as the Vatna Jokull, situated on the south-eastern side of the island, is at present wholly unexplored. Mr. Watts visited Vatna Jokull and spent some time upon it in 1871, in company with his friend Mr. John Milne, F.G.S. So far as they could determine, Vatna Jokull, with its surrounding jökulls, was an aggregation of volcanoes and glaciers, encompassed on all sides by a desert formed by the action of the sea, huge lava streams, and fragmentary ejectments and detritus brought down by the flooded rivers incidental to volcanic eruptions. The object of the proposed expedition is to cross and explore Vatna Jökull, to reach, if possible, the seat of present volcanic activity, and to determine the character and position of any other phenomena it might contain. In order to accomplish this it is essential that his party should not be less than six in number. Three gentlemen have already promised to accompany him, and he hopes that from the club, or others who might hear of his undertaking, he may get four more to join him. He proposes to start on May 31, and remain away about three months, and that should his party consist of eight the expenses would not exceed 50*l.* per man.

A NEW drug from Brazil has appeared in France, under the name of Jaborandi. It consists of the leaves and small branches of a shrub growing in the interior of some of the northern provinces of Brazil, and from specimens which have come into the hands of Prof. Baillon, it seems that the plant is the *Pilo-*

carpus pinnatus Lem., belonging to the Rutaceæ. It is stated that this drug has been used with great success in France, and that it is looked upon "as an incomparable diaphoretic and sialogogue." Dr. Gubler expresses himself in the belief that it "will be the first indisputable example of a diaphoretic truly worthy of the name; that is to say, a medicine having the power of provoking directly by an electric action the secretion of perspiration."

IN the same manner as the lichen dyes have been superseded by those derived from coal tar, so the demand for madder roots seems to be rapidly falling off, owing to the discovery of alazarine. In a report on the trade of Beyrout, it is stated that heavy losses have been incurred in the article, owing to its great fall in value in the English markets from the cause above stated; indeed it is said that so far as England is concerned, the trade in this article with Beyrout has almost, if not quite, ceased. Its cultivation, however, in this neighbourhood, has never been on a very extensive scale, being confined to a few outlying districts; it is, moreover, very exhaustive to the soil. Nevertheless, in the early part of the year 1872, 2,300 cwt. of the value of 5,728*l*. were shipped from Beyrout to English ports.

WE have just received the publications of the "Bataviaasch genootschap van Kunsten en Watenschappen" for 1873. In the "Tijdschrift" is a short paper on Rotti, by Mr. Jackstein, a missionary in the island, followed by another paper by him on the Rotti words in use by the Malay-speaking people in the district of Koepang. Several papers are devoted to the accounts of the suppression of piracy, which has so long been a characteristic of the Malay race. Dr. Adolf Meijer has also communicated a paper On the Language spoken in Mendanoa, Solog, &c.

PROF. WILLIAM M. GABB, of Philadelphia, who is at present engaged in an exhaustive geological exploration of Costa Rica, has lately made a very important discovery in reference to the sedimentary rock on the Atlantic slope of Costa Rica, namely, that even such portions as are auriferous are not earlier than the Tertiary. Indeed, in Prof. Gabb's opinion, they are of Miocene age, which is, of course, strongly in contradiction of the hypothesis of Sir Roderick Murchison, that gold is of Silurian origin.

THE last part of the Transactions issued by the Geological Society of Manchester contains a paper by Mr. S. Aitken, On the Discovery of the new Fish of the Genus *Acrolepis* Ag. in the millstone grit near Habden Bridge, Yorkshire. There is also a paper On the Economic Value of Heat Fuels, by Mr. Plant.

A CURIOUS phenomenon happened at Belfast recently while some men were sinking a well. A light having been let fall, a flash overspread the bottom of the well; and a pipe about 60 ft. long having been conveyed from the bottom of the well to the second storey of a building, the gas was ignited, and continued burning all day. The strata passed through in digging the well were esturine, clay, gravel, boulder clay, and New Red sandstone. The gas has been proved to be marsh gas (carburetted hydrogen) probably generated in the decomposed vegetable matter, which abounds in the lower stratum of the esturine clay, in which were also vast numbers of fossil shells.

ONE of the most elaborate mineralogical papers that has appeared for some time in the United States, with the exception of Dr. Genth's on corundum, is that by Prof. Josiah P. Cooke, jun., upon the vermiculites, and their crystallographic and chemical relations to the micas, together with a consideration of the variation of the optical angle in these minerals. This appears in the Proceedings of the American Academy of Arts and Sciences, and is to be considered as a very valuable contribution to the science of mineralogy.

WE have received a very interesting map of Victoria showing the distribution of forest trees in that colony by an ingenious arrangement of different colours. It is compiled by Mr. Arthur Everett from the Record Maps in the Office of the Surveyor-General, under the direction of Mr. R. Brough Smith. The map is accompanied by notes on the various trees by Dr. F. von Mueller, Government Botanist.

A MADEIRA correspondent writes us concerning the damage caused to objects of natural history from cedar-wood cases. A naturalist in Madeira, to do his collection of the remarkable land shells of the island more honour, had made for them a case of this wood. Unobserved for a month, the shells were found drenched with the turpentiny resin exhaling from the wood. Shells covered with a rough epidermis seemed to have attracted the oil less. *Craspedopoma*, and the smooth fresh-water shells had specially suffered; semi-fossils full of sand had escaped; all others, whether recent or semi-fossil, had suffered to such an extent that the cardboard to which they were attached was in many cases soaked. This occurred, however, only when the affixed shells offered the needful point of attraction and condensation.

WE have received an appendix to the Annual Report for 1873 upon the Survey of the (U.S.) Northern and North-western Lakes in charge of Major C. B. Comstock. Notwithstanding much unfavourable weather, a great deal of work has been done. It was expected that a continuous chain of triangulation, reaching from St. Ignace Island, on the north shore of Lake Superior to the southern end of Lake Michigan, a distance of 500 miles, would be completed during 1873. It has been measured with sufficient precision to give an arc of the meridian 7° in length. This is the longest arc measured on the American continent, and it is hoped to extend it further south.

THE additions to the Zoological Society's Gardens during the last week include a Capybara (*Hyrochærus capybara*) and a Coypu (*Myopotamus coypus*) from S. America, presented by Dr. H. Young; a Garnett's Galago (*Galago garnetti*) from E. Africa, presented by Mr. R. H. Cusack; an African Civet Cat (*Viverra civetta*) from the Gold Coast, presented by Mr. W. B. Ramsay; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. H. Humphry; a Sun Bittern (*Eurypyga helias*) and seven Upland Geese (*Chloephaga magellanica*) hatched in the gardens; a Black Saki (*Pithecia satanas*) and a Red-backed Saki (*P. chiropotes*) from S. America, deposited; a Blue-faced Green Amazon (*Chrysotis bouqueti*) from Honduras, purchased. Of this last-named bird Dr. Finsch, in his monograph on the parrots, remarks that he has never been able to find a skin in any of the many museums to which he has had access.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for March contains the following papers read before the Society:—On the preparation of standard trial plates to be used in verifying the composition of coinage, by W. Chandler Roberts, chemist of the Mint. The author had been instructed by the Lords of the Treasury to prepare new plates of gold and silver for comparing annually with the coinage being issued, in order to guarantee the fineness of the latter. The gold plate consists of an alloy of copper and gold ranging in composition in its different parts from 916·5 to 915·7 parts of fine gold in 1,000 (the standard is 916·66). This plate did not present much difficulty in its preparation, since the two metals were obtained in a state of perfectly homogeneous mixture after repeated meltings. The silver plate presented much greater difficulty owing to the tendency of the silver to concentrate itself in the centre of the mass. The difficulty was overcome by casting the alloy into a plate, which was then planed down on both surfaces and afterwards greatly extended by rolling; a portion cut out from the side of this plate served for the new trial plate. Its composition ranges from 924·6 to 925·1 parts of pure silver per 1,000 (925 being the standard). The author has also constructed supplementary plates of pure silver and gold. An interesting table of assays of trial plates from 1477 down to the present time is given.—Mr. J. Hannay contributes a description of a sp. gr. apparatus for temperatures other than atmospheric.—Dr. Gladstone and Mr. Tribe give the fourth part of their researches on the action of the copper-zinc couple on organic substances. They have now turned their attention to the series containing the C_nH_{2n-1} radicals, the first body acted upon being iodide of allyl, which yields with the dry couple a resinous body of the formula $n(C_3H_4)$, but when mixed with ether rapid decomposition sets in at ordinary temperatures, and the ethereal solution gives zinc oxide on mixing with water. All attempts to isolate zinc-allyl have, however, failed. Allyl iodide and water acted upon by the couple give propylene $C_3H_5I + H_2O + Zn = ZnI.HO + C_3H_6$. The iodide mixed with alcohol is acted upon violently by zinc alone yielding propylene $C_3H_5I + C_2H_6O + Zn = Zn\left\{\begin{matrix}C_2H_5O\\ I\end{matrix}\right. + C_3H_6$.—On ferrous anhydro-sulphate, by T. Bolas. A mixture of ·10 per cent. of a saturated aqueous solution of ferrous-sulphate with oil of vitriol deposits, on cooling, small white prismatic crystals having the formula FeS_2O_7. When exposed to moist air the anhydro-sulphate yields granular crystals of the formula $FeSO_4.6H_2O$.—On tetranickelous phosphide, by Dr. R. Schenk. This substance (Ni_4P_2) was obtained by adding a sufficient quantity of tartaric acid to a solution of nickelous chloride, to prevent precipitation by potash, boiling the potash solution with phosphorus and then drying the precipitate in a stream of hydrogen. The remainder of the journal is devoted to the usual abstracts from other journals, British and foreign.

Poggendorff's Annalen der Physik und Chemie, No. 2, 1874.—In the commencing paper, by M. Hermann Herwig, it appears demonstrated that the conducting power of mercury, for heat, is perfectly constant between 40° and 160°.—A continuation of Julius Thomsen's Thermo-chemical Researches treats of several agents of oxidation and reduction; and in the next paper, Dr. Rontgen discusses several points connected with M. Kundt's dust-figures (produced when a metallic plate, strewn with lycopodium, receives an electric spark): the dependence of the size of the dust-circle on the nature of the gas in which the discharge occurs; on the thickness of the lycopodium layer; on the distance of wire-point from plate; and on the kind of electricity that is in the plate. He also studies the mode of production of the figure, the nature of the discharge, and the phenomena to which Prof. Guthrie lately called attention.—The concluding portion of M. Braun's paper on elastic vibrations whose amplitudes are not infinitely small, is given. Various experiments were made with steel rods, and it is shown that the pitch of tone decreases if the amplitude increases, and that with high tones the influence of amplitude is greater than with low. The deadening is dependent on pitch of tone (being greater for higher tones), on amplitude (the influence of which is also greater the higher the tone), and on figure of vibrations (those in one direction being more deadened when there are simultaneous vibrations in the direction at right angles).—This article is followed by a translation of Prof. Roscoe's account of a self-registering instrument for meteorological measurements of light.—A paper by M. Friedrich C. G. Müller (first part) has for its subject galvanic polarisation, and the distribution of the current in electrolytes. The author's experimental plan was (1) to vary the section and length of a parallelipipedal electrolyte, and the size of the pole plates, and determine each time the resistance; (2) to insert metallic conductors of small resistance (*e.g* thick copper-wire) in the long direction of the liquid conductor, but not touching the electrodes, and measure the increase of conduction; (3) to measure the current-density in different portions of any section by the electrolytic action taking place on a small plate brought to that part.—M. Avenarius has a paper On internal latent heat, in which he arrives at the conclusion that the temperatures (determined by direct observations) of the volatilisation of a liquid in a hermetically-closed space, perfectly agree with those calculated on the basis of empiric formulæ for internal latent heat. The experiments were made with ether, sulphide of carbon, chloride of carbon, and aceton.—Prof. Julius Kohn proposes a simplification of König's method of manometric flames, doing away with the membrane, and making the sound pass from the mouth of an organ-pipe, *e.g.* through a narrow glass tube, directly to the base of the flame (whose motions are mirrored in the revolving case, as usual).—In an article On the motion and action of glaciers, Dr. Pfaff describes some very delicate measurements he lately made on the Aletsch glacier, which seemed to prove that the progressive motion of the ice took place without any break. A minimum motion of 8 mm. per hour was observed at noon, and a maximum of 30 mm. about 5 P.M.; the latter being thus nearly four times the former. Dr. Pfaff also urges a number of considerations against certain theories of valley-formation by glaciers.—The only remaining paper is one On function of magnetisation of various iron bodies, by Prof. Stoletow, of Moscow.

Der Naturforscher, March.—In this number are described a series of experiments by M. Hansemann, who considers they demonstrate the production of a difference of temperature, in columns of air, by the attraction of the earth.—An account is given of recent observations by Dr. Boltzmann, on what he calls "dielectric action at a distance." If the hypothesis be correct (he argued), that in the molecules of an insulator, by electric forces, positive electricity is driven to one side and negative to the other, then an originally unelectrified, insulating body brought near one which is charged with electricity, must be attracted by it, simply through dielectric polarisation of the molecules, and without conduction; in fact, as a piece of soft iron is attracted to a magnet. Experiment confirmed this; and he determined, by his new method, the "dielectric constants" of several insulating substances.—We might here also call attention to M. Barthelemy's striking experiments in vibration forms, produced at the surface of liquids by means of vibrating tuning-forks. In square vessels containing mercury, systems of bright lines appear parallel to the sides, and the breadth of the waves is in inverse proportion to the number of vibrations. In this way is explained Prof. Tyndall's observation that many liquids are not set in wave-motion by vibrations. Such is the case when the breadth of the waves is greater than the breadth of the vessel; there can only then be a motion of the whole surface. The distance between two lines corresponding to the same pitch of fork is found to be independent of the density of the liquid. M. Barthelemy experimented also with round, three-cornered, and elliptical vessels, and on the rhythmical vertical flow of water from narrow orifices.—M. Sporer adduces evidence of the presence of ascending and descending currents in the atmosphere of the sun.—There are also, in the physical department, notes of Helmholtz's researches on galvanic polarisation in gasless liquids, Lockyer's on spectrum analysis of metals, Tyndall's on conduction of sound through the atmosphere, &c.—In geology, we find a summary of M. Laube's late observations as to the evidence of a much more intense Ice-period in Greenland than the present; while M. Fuchs describes the geological formation of the region about Nizza, south of the Maritime Alps.—Two curious cases of mimicry in the Articulata are discussed in a note by M. Gerstaecken, who theorises on the nature of the general phenomenon; and there is, in the same section, a paper by M. Milne-Edwards, in which the colour of birds is studied in relation to their geographical distribution.—In botany, lastly, the following topics are treated; immigration of a rust fungus, *Puccinia malvacearum* (from Chili); light and the regeneration of albuminous matter from asparagine; and the electrical phenomena in the leaves of Dionæa.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 30.—On Leaf arrangement, by Hubert Airy, M.A., M.D. Communicated by Charles Darwin, F.R.S. Received March 23, 1874.

The author is led to suppose:—

I. That the original form of leaf-arrangement was two-ranked.

II. That this original two-ranked form gave rise to forms with 2, 3, 4, 5, 6, 7, &c., ranks, by "sporting," as opposed to any process of accumulative modification.

III. That, of the orders so formed, those with an even number of ranks (except 2) have, as a rule, assumed a *whorled* arrangement, and those with two or an odd number of ranks have assumed an *alternate* arrangement, under the need of lateral accommodation of ranks in the bud (taken as type of close-packed forms).

IV. That all those orders have been subject to vertical condensation, under the need of vertical economy of space in the bud (taken as type of close-packed forms).

V. (*a*) That such condensation operating on a 2-ranked or 3-ranked or 5-ranked alternate order $\left(\frac{1}{2}, \frac{1}{3}, \frac{2}{5}\right)$ has produced subsequent orders of series A $\left(\frac{1}{2}, \frac{1}{3}, \frac{2}{5}, \frac{3}{8}, \frac{5}{13}, \frac{8}{21}, \frac{13}{34}, \frac{21}{55}, \frac{34}{89}, \frac{55}{144}, \&c.\right)$.

(*b*) That condensation of a 7-ranked $\left(\frac{2}{7}\right)$ or rarely of a 3- or 4-ranked $\left(\frac{1}{3}, \frac{1}{4}\right)$ alternate order has produced subsequent orders of series B $\left(\frac{1}{3}, \frac{1}{4}, \frac{2}{7}, \frac{3}{11}, \frac{5}{18}, \&c.\right)$

(*c*) That condensation of a 9-ranked $\left(\frac{2}{9}\right)$ or rarely of a 4- or 5-ranked $\left(\frac{1}{4}, \frac{1}{5}\right)$ alternate order has produced subsequent orders of series C $\left(\frac{1}{4}, \frac{1}{5}, \frac{2}{9}, \frac{3}{14}, \frac{5}{23}, \&c.\right)$.

(*d*) That condensation of a 4-ranked whorled order (whorls of two) has produced successive orders of series a, with spirals in sets of 4, 6, 10, 16, 26, 42, &c

(*e*) That condensation of a 6-ranked whorled order (whorls of three) has produced successive orders of series β, with spirals in sets of 6, 9, 15, 24, 39, &c.

(*f*) That condensation (if any) of an 8-ranked whorled order (whorls of four) would produce successive orders of series γ, with spirals in sets of 8, 12, 20, 32, &c. Higher numbers of ranks would lead to higher series.

The Structure of the Mucous Membrane of the Uterus and its Periodical Changes, by John Williams, M.D., Assistant Obstetric Physician to University College Hospital. Communicated by Dr. Sharpey.

On the Improvement of the Spectroscope, by Thomas Grubb, F.R.S.

The author refers to a statement appearing in the "Astronomical Notices" for March, viz. that the spectral lines can be rendered perfectly straight, simply by returning them (after their first passage through a series of prisms arranged for minimum deviation) by a direct reflection from a plane mirror; and further, that this has been accomplished in a spectroscope in construction for the Royal Observatory. He then shows reasons for doubting the accuracy of this statement.

The remedy, or means of producing straight spectral lines, which the author has alluded to is simply that of constructing the "slit" with curved edges instead of rectilinear. There is but little practical difficulty incurred in construction and no apparent objection to its use. It may be objected that for such variation of prism power in use there should be a special slit. It is, however, only in spectroscopes arranged for high dispersion that the curvature becomes objectionable; in such there is seldom a change required, and a single slit of medium balancing power would probably remove all practical difficulty or objectionable curvature of the lines. The author has found by trial, that when two compound prisms were in use, giving a dispersion from A to H of nearly 14°, that the spectral lines were straight in a field of one degree when the radius of curvature of the slit was made 1·25 inch.

Zoological Society, May 5.—Dr. E. Hamilton, vice-president, in the chair.—The secretary read a report on the additions that had been made to the Society's Menagerie during the month of April 1874, amongst which were a Vigne's Sheep (*Ovis vignei*), presented by Capt. Archibald; a white-cheeked flying squirrel (*Pteromys leucogenys*), presented by Mr. A. Gower; a new kangaroo (*Halmaturus luctuosus*), deposited by Sig. L. M. d'Albertis, and four bladder-nosed seals, presented by Capt. D. Gray and Capt. Alexander Gray.—Mr. Sclater made some remarks on the cassowary, living in the Society's Gardens, hitherto called Kaup's cassowary, which, it appeared, ought to bear the name *Casuarius papuensis.*—Mr. Sclater announced that H.M. Government had consented to send a Naturalist to Kerguelen's Land to accompany the Astronomical Expedition shortly proceeding there, and that the Rev. A. E. Eaton had been selected by the Royal Society for the post.—Mr. Blandford exhibited and made remarks on a series of heads of the Ibex of Persia, which he considered to be referable to *Capra ægagrus.*—Mr. A. H. Garrod read a paper on the anatomy of the Columbæ, in which a new arrangement of that group of birds was proposed, based upon certain points not hitherto sufficiently investigated.—A communication was read from Dr. Julius Haast, containing the description of a new species of *Euphysetes* (*Euphysetes pottsi*), a remarkably small catodont whale, which had occurred on the coast of New Zealand.—A communication was read from Mr. Frederick Moore, containing a list of Diurnal Lepidoptera collected in Cashmere by Capt. R. B. Reed, 12th Regiment, with descriptions of new species.—A communication was read from Mr. A. G. Butler, containing a complete list of the known Diurnal Lepidoptera of the South Sea Islands.—Mr. Howard Saunders read a paper on the Grey-capped Gulls, in which several species hitherto confounded were distinguished.—A paper was read by Dr. A. Gunther, F.R.S., entitled A contribution to the fauna of Savage Island, in which several new lizards peculiar to the island were discribed, and other animals found in i were mentioned.—A communication was read from Dr. J. S. Bowerbank, F.R.S., containing the sixth part of his "Contributions to a General History of the Spongiadæ."—Mr. R. B. Sharpe read a paper on a small collection of birds made in Bulama, one of the Bissagos Islands, West Africa, by Lieut. Bulger.

Chemical Society, May 7.—Prof. Odling, F.R.S., president, in the chair.—A paper On the action of ammonia on phenylic and cresylic chloracetamide, was read in French by the author, Dr. D. Tommasi.—Researches on the action of the copper-zinc couple on organic bodies; Part VII. On the chloride of ethylidene and ethylene," by J. H. Gladstone, F.R.S., and A. Tribe, F.C.S. The authors find that these two isomerides behave differently when treated with the couple, the latter splitting up into ethylene and chlorine, whilst the former gives zinc chlorethylate, $\left.\begin{matrix}C_2H_5O\\Cl\end{matrix}\right\}Zn$.—Mr. Charles E. Groves then read a note On the preparation of ethyl chloride and its homologues. He finds that when hydrochloric acid is passed into a boiling solution of zinc chloride in alcohol, the latter is completely converted into ethyl chloride; other alcohols, such as the methylic and amylic, under similar treatment yield the corresponding chlorides.—On a new mineral from New Caledonia, by Mr. A. Liversidge.

Geological Society, April 29.—John Evans, F.R.S., president, in the chair.—The following communications were read:—On the Gault of Folkestone, by F. G. H. Price. The author divided the Gault into two great sections, Upper and Lower Gault, which he again subdivided into eleven well-defined zones, mostly named after characteristic ammonites. Each of these zones or beds is numbered, commencing with No. XI., the zone of *Ammonites interruptus*, which bed forms the base of the Gault, reposing upon the Folkestone beds of the Upper Neocomian. He found the thickness of the deposit at Copt Point to be 99 ft. 4 in.—On the Cretaceous Rocks of Beer Head and the adjacent cliff-sections; and on the relative horizons therein of the Warminster and Blackdown fossiliferous deposits, by C. J. A. Meyer. The author remarked that in advancing westward from the Isle of Wight the cretaceous rocks diminish steadily, although unequally, in thickness, and change slightly both in mineral character and fossil contents, while the base of the series rises gradually in the cliff-sections. The chalk-cliffs of Beer Head, the most westerly chalk promontory in England, owe their preservation, in his opinion, partly to a local synclinal arrangement of the strata. The cretaceous rocks of the district include the following, in descending order:—

Upper Chalk (in part) ?
Medial Chalk.
Lower Chalk.
Chalk Marl.
Chloritic Marl.
Upper Greensand.
Gault.
(?)

Royal Astronomical Society, May 8.—Sir G. B. Airy, vice-president, in the chair.—Prof. Otto Struve read a paper On the irregularities in the proper motion of Procyon. He said that last year Prof. Auwers of Berlin had expressed grave doubts as to the possibility of the minute companion of Procyon being sufficiently large to account for the observed irregularities in the motion of the principal star; he had calculated that it would be necessary to assume for Procyon a mass eighty times as great as that of our sun, and for the perturbating companion a mass at least five times as great as that of our sun. He had further calculated that if the minute companion were the perturbating body, it should, at the beginning of this year, occupy a position-angle 9° or 10° greater than that occupied by it last year, whereas if it were only a small star, situated in the neighbourhood, the observed proper motion of Procyon would carry it forward so as to diminish the position-angle of the companion by about 4°—on recently examining Procyon he had found that the companion had moved forward during the year from a position-angle of 87¼° till it now occupied a position-angle of 96°. He was therefore disposed to think that there could now no longer be any doubt that the minute companion is the perturbating body, which accounts for the irregularities in the motion of the primary. —Mr. Glaisher gave an account of some MS. volumes of twelve figure-logarithms which have recently been presented to the Society by the executors of the late Mr. Thompson of Greenock, the table of logarithms of numbers extends as far as 120,000. No account has been left of the way in which Mr. Thompson obtained the logarithms of the prime numbers, but from internal evidence Mr. Glaisher was inclined to think that they had been independently calculated. He attached great value to the manuscripts. No table of twelve-figure logarithms has as yet been published. Mr. Glaisher estimated that the cost of printing these tables would be about 1,000*l*.

Royal Microscopical Society, May 6.—Charles Brooke, F.R.S., president, in the chair.—A paper by Dr. Anthony, On the suctorial organs of the blow-fly was read to the meeting. The paper suggested that the so-called pseudo-tracheæ were really sucking or pumping organs.—A paper was read by Mr. Slack On certain silica films artificially produced, in which the results of a number of interesting experiments and observations were detailed; and Mr. W. T. Read communicated to the meeting the results of similar researches, in which he had recently been employed.—A paper by Dr. Royston-Pigott was taken as read, On the use of black shadow markings, and on a black shadow illuminator.

Entomological Society, May 4.—Sir Sidney Smith Saunders, president, in the chair.—Mr. Butler exhibited an example of arrested development in a Peacock butterfly caused by the tail of the pupa having become detached during the process of emerging, the right wings being completely developed, whilst those on the left side were not developed at all, the pupa case remaining attached to the left side of the body of the butterfly.—Mr. W. C. Boyd exhibited specimens of *Solenobia inconspicuella*, taken in St. Leonard's Forest, and amongst them a specimen of a remarkably pale colour, which might possibly be an Albino variety; but it had a very different appearance from the ordinary form.—Mr. Boyd also exhibited some leaves of the common Comfrey (*Symphytum officinale*), gathered at Cheshunt, the undersides of which were found to be completely covered with specimens of *Brachycentrus sub-nubilus*. All were said to be males, but on close examination a single female specimen was discovered amongst them.—Mr. C. O. Waterhouse read a note by Dr. Lamprey, Surgeon-Major 67th Regiment, On the habits of a boring beetle, one of the *Bostrichidæ*, found in British Burma. It belonged to the genus *Sinoxylon*. Dr. Lamprey did not know the name of the tree on which it was found; but he described the insect as making a small hole in a stem that was about ½ in. in diameter; and by devouring the wood completely round, severed it with a clean cut, so that it was only kept together by the thin outer layer of bark, the first gust of wind snapping off the weakened branch. The beetle turned on its side while boring, its back being towards the bark, and in this way its form appeared to adapt itself to the circumference of the stem.

PARIS

Academy of Sciences, May 4.—M. Bertrand in the chair.—M. Jamin presented a communication on the depth of the magnetised layer in a steel bar. The author announced as the result of his experiments that in a thick steel bar there is no magnetisation in the centre, and that the elemental bars composing the magnet do not begin to appear till 3 or 4 millimetres from the surface, but become more and more numerous and contracted against the free surface.—Study of and experiments upon the metallic sulphides, by M. Berthelot, a continuation of former thermo-chemical researches.—Observations on the fecundation of the urodelous batrachians, by M. Ch. Robin. The fecundation of the oviparous urodelous batrachian (*Siredon*, *Triton*), like that of the *Anoura*, is internal.—Observations concerning a recent communication by M. Faye relating to a calculation by Pouillet of the cooling of the solar mass, by M. A. Ledieu. The author has arrived at a result not quite in accordance with that obtained by M. Faye in his recent calculations.—M. Favre presented the continuation of his researches on hydrogen. The condition of this gas when absorbed by palladium and by platinum black is in no way comparable in these two cases. In platinum black the condensed gas is not chemically modified, but in palladium it undergoes an allotropic modification before combining with the metal. The author in concluding called attention to the importance of thermic measurements of chemical phenomena; notably of the allotropic changes of bodies.—On the action of distilled water on lead by M. Is. Pierre. Water condensed in a leaden worm was found to contain about ·000375 grms. of Pb. per litre.—Report on the apparatus intended for the operation of the transfusion of blood, presented to the Academy by MM. Moncoq and Matthieu.—On the illumination of opaque bodies by neutral or polarised light, by M. A. Lallemand. —Determination of clay in arable soil, by M. T. Schlœsing.—On gravitation, cohesion, and the distances of the centres of molecules, by M. G. West.—M. Ad. Chatin presented a continuation of his researches on "organogenesis compared with androgenesis in its relations with natural affinities." The classes treated of were Polygalaceæ and Æsculinaceæ.—Influence of vernal heat on *Phylloxera vastatrix*, by M. M. Cornu. The insect changes from brown to bright yellow and becomes larger. —On the integrals of the differential equations of curves which have an even polar surface, by M. l'Abbé Aoust.—Phenomena observed on Jupiter's satellites, by M. C. Flammarion. The author's observations lead to the hypothesis of the existence of an atmosphere surrounding the second and third of the planet's satellites.—On the reflecting power of flames, by M. J. L. Soret. Experiments have shown that carbon preserves its reflecting power at very high temperatures, thus confirming Davy's theory of the luminosity of flame, since a ray of sunlight reflected from a bright flame is polarised in precisely the same manner as when reflected from non-luminous smoke.—Study of the properties of explosive bodies, by M. F. A. Abel. Third memoir.—Note on a process for determining phosphoric acid, by M. F. Jean. Influence of the presence of nitrogen in the textile fibre on the direct fixation of the aniline colours, by M. E. Jacquemin.—On the physiological phenomena observed in the high regions of the atmosphere, by M. Barral.—On the study of the fumeroles of Nisyros and of some of the products of the eruption of 1873, by M. H. Gorceix.—Partial resection of the calcaneum; absolute anæsthesia produced by an intravenous injection of chloral; immediate cessation of anæsthesia after the operation by the application of electric currents, by M. Oré.—On the mechanical aptitude of horses, by M. A. Sanson. —On the occurrence of a Cycada in the Miocene deposit of Koumi (Eubée), by M. G. de Saporta. This insect (*Encephalartos gorceixianus*) is the first fossil Cycada that is capable of being referred without anomalies to a living genus. The discovery enables the author to affirm that a Cycada belonging to a genus now confined to South Africa inhabited Miocene Europe: in the same manner this region supported at a somewhat later period the African type of rhinoceros, giraffes, and antelopes, thus giving greater probability to the hypothesis of a union between Austro-oriental Europe and Africa, during the Miocene period.

CONTENTS

PAGE
THE SCIENCE COMMISSION 21
OUR BOOK SHELF 23
LETTERS TO THE EDITOR:—
  Flowers of the Primrose destroyed by Birds.—CHARLES DARWIN, F.R.S. 24
  Mr. Spencer and *à priori* Axioms.—R. B. HAYWARD 25
  The Glacial Period.—THOMAS BELT 25
  Lakes with two Outfalls.—W. STANLEY JEVONS 26
  Trees Pierced by other Trees.—G. GREENWOOD 25
  The supposed Antipathy of Spiders to Chestnut Wood 26
AN EXPERIMENTAL OBSERVATION ON HAY FEVER. By Prof. BINZ . 26
THE COMING TRANSIT OF VENUS, IV. (*With Illustrations.*) By Prof. GEORGE FORBES 27
LARVÆ OF MEMBRACIS SERVING AS MILK-CATTLE TO A BRAZILIAN SPECIES OF BEE. By HERMANN MÜLLER (*With Illustrations*) . . 31
THE MAMMALS OF MOUPIN 32
THE TRANSIT EXPEDITIONS TO RODRIGUEZ AND KERGUELEN'S LAND 33
NOTES 33
SCIENTIFIC SERIALS 35
SOCIETIES AND ACADEMIES 36

THURSDAY, MAY 21, 1874

ON THE ACTION OF THE HORSE

NO dynamical problem, whether physical or biological, can be considered to be based on a substantial foundation until some method has been applied to it, by which an accurate statical record can be obtained of the exact relations of all the forces which, at any given moment, operate in its production. The great preparations which are just completed for the observation of the approaching transit of Venus show how difficult it sometimes is to obtain the desired results; and the value attached to the production of photographic records of the phenomenon proves the importance of permanent registration.

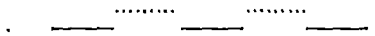
The movement of the legs of quadrupeds during progression is a difficult problem, as is shown by the fact that there are still many contradictory opinions maintained by high authorities on the subject. The difficulty in this case depends on there being the four different limbs to be considered at the same time, which it is impossible to do without a considerable amount of practice. Till lately, those who have studied the point, as far as the horse is concerned, have relied on their sight or hearing, and have checked their results by the impression left on the ground by the animal's hoofs. The observational power of each individual author has therefore always been an element in the problem, and it is very difficult to estimate the magnitude of that part of it, in any given case, correctly. Within the last few years, however, a much improved method has been introduced, which, judging from the discussion that has been carried on in the *Times* with reference to the attitude of the horse in Miss Thompson's picture of the "Roll Call," is but little known by some who have very decided opinions on the movement of the legs.

In a work, published last year, entitled "La machine Animale," by the eminent French physiologist, M. E. J. Marey, of Paris, a full account will be found of an apparatus constructed by the author, by means of which the movements of each of the legs of the horse during progression are synchronously registered on a uniformly moving strip of paper, in such a way that the tracings obtained from all the four can be superposed and compared at the leisure of the experimenter, and the simultaneous positions of each leg accurately estimated. What is more, M. Marey has also introduced a beautiful writing language, as it may be termed, by means of which it is as easy as in music to transcribe the results obtained with his instrument and read them off in their proper sequence. A knowledge of this language makes it possible to refer any given position, such as that of the horse in the "Roll Call," to it; from which it may be compared with the results obtained by direct experiment. Such being the case, it is not difficult to transfer the vagueness of "opinion" into the certainty of fact, and settle a question once for all.

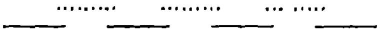
M. Marey's method is the following:—The record of the movement of each limb is obtained by the employment of small caoutchouc bags filled with air, similar in most respects to those with which he has obtained such valuable information on the movements of the heart. Two of these bags are connected together by an india-rubber tube; one is placed in contact with the foot, and the other with a small lever which writes on the recording paper. Each leg is provided with its pair of bags. Movements in either foot compress the bag connected with it, and this, by distending that at the other end of the tube, raises the lever. The levers write, one above the other, on a revolving drum held in the hand of the equestrian. We must refer our readers to the work itself if they desire to see the tracings obtained, mentioning that at the moment each foot touches the ground a sudden rise of the lever is the result, which is followed by an equally abrupt fall immediately it quits it.

Results even more satisfactory than those obtained by the use of the above-described air-bags might be obtained by adapting a simple electrical contact-maker and wirer to the shoes of the horses, which by acting on small electro-magnets would produce movements on levers which recorded similarly to those employed by M. Marey.

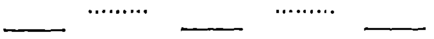
It will be necessary to give a short description of the mechanism of walking generally in order to explain that of the horse. Man in walking on level ground gives sufficient impulse to the body at each step to enable him to lift the one foot at the instant that the other touches the earth. Representing the time of contact of the right foot by a continuous line, that of the left foot by a superposed dotted line, and the exact period of the interval between the raising and lowering of either foot by the gap between the succeeding lines, the human walk on level ground would be drawn thus:—



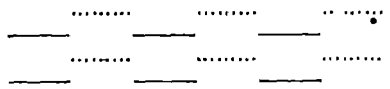
Whilst going uphill, however, there is a period during which both feet are on the ground together, which may be indicated thus:—



Whilst, again, in running, there are periods, as we all know, during which both feet are off the ground together thus:—

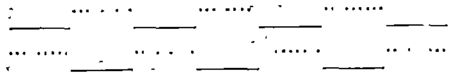


Turning to the case of the horse, and using the same method of illustration, we may employ the excellent comparison suggested by Dugès, in which he shows that any of its different steps may be imitated by two men, one behind the other. Now suppose these men, the hinder one with his hands on the shoulders of the one in front, to walk "in step," that is, with the right and left feet moving simultaneously; then, if their movements be recorded as above, with the steps of the hind man placed below those of him in front, the following would represent them:—

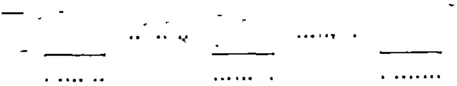


both would have their similar feet off and on the ground at the same time; and reverting to the horse, this formula, as it may be termed, which represents the legs of the same side off the ground together, is that of the "amble," a method of progression natural to the giraffe, but only acquired by special training in the horse.

Again, suppose that two men, instead of walking "in step," do exactly the opposite, that is, place the *opposite* feet forward simultaneously; we then have the following formula:—



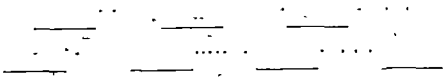
All will recognise this as the "trot" in the horse; although, as M. Marey has proved, there is always, in the true "trot," an interval between each of its two elements, during which all the feet are off the ground at once, thus:—



the upper of the last two formulæ, however, represents the walk of the elephant exactly.

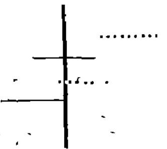
In the amble and the trot, therefore, each complete series of steps is formed of two parts which never overlap; it follows that the sounds produced by them are double also.

The walk of the horse is a phenomenon a little more difficult to realise at first sight. Again referring to the two men, suppose that they walk quite out of step, as it may be termed, in such a way that the front one *has raised* his right leg at the same moment that the hind one is *just raising* his, although they keep to the same number of steps. Such being the case the sequence of the steps would be *right front*, *left hind*, *left front*, and *right hind*, which is the order of succession in the horse, and may be represented thus:—



In this formula it is seen that at no time are there more than two feet on the ground at the same moment, and M. Marey states that in his numerous experiments such is always the case, except when a load is being taken down an incline in a wheeled vehicle, on which occasion three feet may be on the ground simultaneously. In the walk of the horse there are therefore four sounds produced in each complete series of steps, and these four are at equal or nearly equal intervals of time.

We are now in a position to judge of the accuracy of Miss Thompson's delineation of the "Roll Call horse," which is represented walking, with the left fore-foot fully raised from the ground, whilst the others are on it. The right fore-leg is nearly perpendicular and not bent; that is, about half-way between the commencement and the end of its step. The left hind-foot is somewhat in front of the perpendicular axis of the leg; that is, has just commenced its step; and the right hind foot, though on the ground, is on the point of leaving it. As the animal is walking, the lengths of the steps and of the intervals must be represented, as shown above, as of equal duration, and the following is its expression, the thick vertical line representing the moment at which the painting figures it:—



By comparing this with the formula of the walking horse, given above, it is evident that the representation is correct, except in a very slight point, which is that the right hind leg is on the ground, though just on the point of leaving it, whereas it ought to be just off it, because in walking there are never more than two legs on the ground at the same time. The general direction of the legs is quite correct. If the animal had been "ambling," the left hind-foot would have been off the ground, as well as the left fore. It is quite impossible to mistake the "walk" for the "trot," if their formulæ are compared and the positions at any given time worked out from them.

A. H. GARROD

CARPENTER'S "MENTAL PHYSIOLOGY"

Principles of Mental Physiology. By W. B. Carpenter, M.D., F.R.S. (Henry S. King & Co.)

THE title of the volume before us shows that its author is one of those philosophers—happily, an increasing number—who refuse to treat the phenomena of mind as though they were in no way connected with the body through which they find their expression. Mental Physiology is a comparatively new science, and does not date further backward than the days of Hartley. Before his time, and to some extent since, Physiology has been treated from what—to employ a word too often pressed into the service of a somewhat hazy idea—may be called the metaphysical point of view. The phenomena of mind have been abstracted from all their surroundings, and have been analysed by themselves, and the result has naturally been that we have been left but little wiser than before. Dr. Carpenter rejects this method, and bases his Psychology on the construction and working of the nervous system. But while shunning the metaphysical treatment of the subject, he does not adopt the other extreme, the doctrine, we mean, of the thorough materialist, who regards all mental phenomena without exception as the outcome of previous physical causes, which necessarily produce certain results. He steers a middle course, inasmuch as, while he advances the theory "of the dependence of the Automatic activity of the mind upon conditions which bring it within the nexus of Physical Causation," yet he believes in "an independent power, controlling and directing that activity, which we call Will."

This doctrine of the independence of the Will is the distinguishing characteristic of Dr. Carpenter's philosophy in the book before us; it runs through the entire work as the one grand exception among a series of physical sequences, interdependent, and standing to each other in the relation of cause and effect, of antecedent and consequent. Yet, even to a mind which is not "trammelled by system," this splendid anomaly may seem strange and surprising, though the prevalence of the belief in a Free Will, even among scientific thinkers, need cause no wonder, so long as the ethical bias is not rigidly excluded from psychological speculation. It is the meritorious timidity of the moral side of human nature which says, "whatever else may be under laws of necessity, the Will at least is free and independent, for the alternative doctrine deprives all actions of their moral value, and reduces man to the level of a mere machine."

It is clear that Dr. Carpenter is not satisfied with the doctrine of the so-called necessarian school indeed, he quotes Mr. Mill's Autobiography in his preface to show that the great necessarian himself wavered in his belief. He clearly thinks the explanation of human conduct offered by those who reject the theory of the independence, or rather the self-dependence, of the Will, inadequate. They would say that the unconscious operation of causes proceeds independently of the conscious conviction of the individual; that however much we may think that of two lines of conduct before us, either is equally possible for the human Will, yet, as a fact, we invariably *follow* the one to the exclusion of the other; the result, as it were, proves the cause, the apparent ultimate choice is the real physical consequent of antecedents engrafted in our nature, and acting in an invariable sequence, though it is true, as shown by Mr. Mill in the sixth book of his Logic, that Science is not sufficiently advanced to enable us to predict successfully the course of human action in any case, owing to the much greater complexity of the influences which operate in determining sociological phenomena when compared with other forms of activity. The necessarian philosopher would say that the operation of the Will is really nothing more than the force of the stronger motive asserting itself. Dr. Carpenter, and with him is the majority of mankind, says that the Will itself determines from within us which motive shall be the preponderating one.

But the chief merit of Dr. Carpenter's book lies, as we have said, in the explanation of the nexus which binds together the physical and the psychical elements in human nature. The well-known authority of what he says on such a subject constitutes the main value of his work. It is not too often that a great physiologist has turned his attention to mental phenomena, and we therefore welcome all the more gratefully any addition to the number of those who base their psychology on an exhaustive analysis of the functions and modes of action of the nervous system. In the first and second chapters of his book—the backbone, if we may so call it, of the work—Dr. Carpenter unravels carefully and exhaustively, step by step, all the interdependences of the nervous system and the psychical states. Without entering on all the mysteries of nervous ganglia and afferent and motor fibres, or the physiological comparison of Articulata and Vertebrata, we would say generally that Dr. Carpenter divides bodily movements in man into three classes:—(1) The primarily automatic; (2) the secondarily automatic; and (3) the volitional. Of these the first two "are performed in respondence to an internal prompting of which we may or may not be conscious, and are not dependent on any preformed intention, being executed 'mechanically'; while the last are called forth by a distinct effort of Will, and are directed to the execution of a definite purpose." But though thus clearly laying down the doctrine of the self-determining power of the Will, the author somewhat qualifies it afterwards, when he says that "even in the most purely Volitional movements the Will does not *directly* produce the result, but plays, as it were, upon the Automatic apparatus by which the requisite nervo-muscular combination is brought into action."

The conclusion at which our author arrives as to the general relations of mind and body is, in his own neatly-expressed words, "that the actions of our minds, in so far as they are carried on without any interference from our Will, may be considered as 'Functions of the Brain.'" These Functions of the Brain and of the Nervous System which supplies the brain with the materials which it works up into sensations and ideas, are lucidly and exhaustively expounded in the second and longest chapter of the work, in which the element of pure physiology preponderates, and into which we do not intend to enter, as no short summary of it can fairly represent its contents. Suffice it to say that in this part of the book Dr. Carpenter shows that the amount of intelligence (not instinct) shown by an animal is in a direct ratio to the relative size of the cerebrum and the sensorium, which latter organ in man is nearly eclipsed by the superimposed cerebral hemispheres, "the instrument of our psychical or inner life;" that the cerebrum is not concerned in the ordinary performance of our automatic movements, though in many cases it exercises control over them; its power, however, does not extend so far as to enable it to interfere with "the nervous system of organic life," or sympathetic system. The ruling monarch here at last meets with constitutional checks. It can exert no modifying influence on the "nutritive operations;" they, together with the rest of the sympathetic system, would rather seem to obey another power when they obey at all, the power, namely, of the emotions, which so often rebel against the Will, being, so to speak, the insurrectionary element which breaks in upon the dignified controlling influence of that thinking, purposeful, though sometimes eccentric monarch.

It is impossible in the short limits of a review to enter into the discussion of the part played by Attention, Sensation, Perception, and other physiological conditions in the production of mental results. These are all minutely treated of by our author, who carries us on in an easy progress from one to another with enviable clearness.

In treating of the succession of ideas Dr. Carpenter follows the doctrines of Prof. Bain in relation to the Laws of Association, and acknowledges the debt he owes to that most conscientious philosopher. All students of Prof. Bain's works on Mental Science are already familiar with the Laws of Contiguity and Similarity as explaining the principles of association of ideas, and we need not dwell further on them. The section which deals with Ideo-motor action is very interesting as leading us into the region of the marvellous. Ideo-motor action may be defined to be "the direct manifestations of ideational states, excited to a certain measure of intensity, or, in physiological language, reflex actions of the cerebrum." It is in this definition that we find the true key to the phenomena of table-turning and spirit-rapping, when practised by those who bring no dishonest arts to bear in their experiments. From this definition we should deductively infer that the revelations which reward those who take part in such experiments must be, as is in fact the case, in spite of assertions to the contrary, revelations of some matter known to at least one of the party engaged in the *séance*, whose mental activity and the play of whose ideas, apart from any exercise of Will, may influence the muscular movements *directly* and the more easily, inasmuch as the strained state of the hands on such occasions, after being stretched out for several minutes, renders them the easy and unresisting instruments of the ideational state, intensified, as it is, by the circumstances which surround it. So independent of volition is the influence of the ideational state in these cases, that it often operates in opposition to the dictates of the Will, and the writer has himself seen, more than once, answers extorted, as it were, from a member of a *séance*, unwillingly on his part, simply in consequence of his own highly-strained ideational condition conveying a knowledge through his muscles to those who sat with him at the innocent and obedient piece of furniture. Dr. Carpenter also shows that under this head of Ideo-motor action may be ranged "all those actions performed by us in our ordinary course of life," such as the use of language to express our thoughts, which requires no separate volitional effort, at all events when once we have entered on a train of speech.

But though giving up so large a field of human life to the non-volitional activity, Dr. Carpenter still keeps the Will in view, as a sort of abstract entity, as a "supposititius," or reserve champion sitting in wait, ready to step in if occasion should call. "The dominant Idea *determines* these movements, the Will simply *permitting* them."

We can give in a few words a summary of Dr. Carpenter's theory of the relation of the Emotions to the Will. He begins by saying that "the Will has no *direct* power over the emotional sensibility," it can only operate to withdraw the attention from the emotional state and fix it determinately upon some other object. Again, the Will "can exert itself in preventing the *expression* of the excited feelings in action" by suppressing the muscular exhibition of our emotional states; and again, "where the Emotion is not a mere *passion*, but is a state of *feeling* connected with some definite *idea*, the power of the Will is most effectually exerted in withdrawing the mind from the influence of that idea, by *fixing the attention upon some other*"—the power of self-control extends itself from our *impulses* to the habitual *succession of the thoughts*.

We had already learnt our author's views on the relation of the Will to mental and bodily action, but in the middle of his treatise we come upon a full and careful amplification of his opinions on this head, developing his theory of the influence of the Will on the formation of beliefs and on the conduct. We cannot do better than give in his own words Dr. Carpenter's doctrine on the latter head:—

> "To carry into *action* the volitional determination, to give to the 'I will' its practical effect, something more is usually needed than the mere preponderance of motives. The idea of *the thing to be done* (which we have seen to be the necessary antecedent of all volitional action) may indeed be so decided and forcible, when once fully adopted, as of itself to produce a degree of nervous tension that serves to call forth respondent muscular movements, as in the purely ideo-motor form of action. But in general a distinct exertion of the Will is needed to give to the ideational state the energy requisite to call forth the action that expresses it, and this is especially the case where either some powerfully opposing motive diminishes the force of the preponderance, or a state of fatigue causes the bodily mechanism to be less easily called into action."

Hitherto we have been dealing with what the author calls "General Physiology;" we come now to the other division of the work, on "Special Physiology," and the transition is marked by a change of matter and style. We feel that, in reading this latter portion of the book we are being rewarded for the care which is necessary to the mastery of the deeper and more valuable philosophy of the earlier chapters. We have got—we do not speak disrespectfully—out of school into the playground, and we revel in the contemplation of the "morbid conditions" of the mind, illustrated as they are by numerous relevant anecdotes. Mesmerism, somnambulism, and dreaming are all subjects which attract and entertain, especially when treated of by a scientific pen. But we feel that this portion of the work does not call for special criticism so much as what we have already gone through. "Morbid conditions" are very valuable as throwing light on the operation of normal and healthy conditions, but happily the epithet "morbid" is interchangeable with the epithet "exceptional," and therefore we think that the morbid does not require such close treatment as the normal.

Dr. Carpenter winds up his work with a chapter on Mind and Will in Nature, and in it brings to a poetical conclusion what he has so carefully and exhaustively unravelled in the preceding pages.

ANDRÉ AND RAYET'S "PRACTICAL ASTRONOMY"

L'Astronomie pratique et les Observatoires en Europe et en Amérique. Par C. André et G. Rayet. Iᵉ partie, Angleterre. (Paris: Gauthier-Villars. 1874.)

THIS little unpretending volume is of considerable importance. Not only is it the commencement of a series which is intended to include the history of practical astronomy throughout the civilised world, but independently of this, it has claims to notice which are not to be measured by its limited dimensions.

The wide outspreading in the present day of a taste for astronomical observation would lead us to regard with favour anything tending to increase our knowledge of what has been and is being done, especially when it is set before us in so pleasing a form; and we cannot but admit that our neighbours have in this respect got the start of us. Notwithstanding all our efforts to render Science generally intelligible and acceptable, we have not yet succeeded in bringing out such attractive little manuals as proceed from the presses of MM. Gauthier-Villars and Hachette. Our larger and more elaborate treatises may well bear a comparison with anything of a similar calibre produced elsewhere; but in familiar, inexpensive, tasteful manuals, the light artillery, so to speak, of the scientific campaign, we must own ourselves fairly beaten by our nearest neighbours, who have set us a worthy example. We cannot, happily, and if we could we would not, say in this instance, *fas est et ab hoste doceri.* There was a time when such a remark would have been thought appropriate, but "nous avons changé tout celà;" and if such a thoroughly ill-natured and reprehensible observation were to be attempted now, it would meet its ample refutation in this work, which adds to its other merits the charm of courteous and kindly feeling. Next to the cordial abandonment of individual hostility, or the loving, tender reconciliation of alienated friendship, what can be more pleasing than the abatement of national antipathies, and the softening down of those asperities which have but too deeply marked the intercourse of different branches of the human race? That nations should think or feel exactly in unison is no more to be expected than that individuals of the same family should possess identical tastes and habits; but as in the smaller, so in the larger groups, these distinctive characters may and ought to exist apart from every unkind jealousy or envious bitterness. There had been far too much of this in past days, and we hail with pleasure the appearance of this friendly book, which has evidently been drawn up in a truly kind and genial spirit.

If it puts us somewhat to shame, that the Assistant-Astronomers of the Paris Observatory should be telling us what goes on at our own doors, we have only ourselves to thank for the omission, and them for the way in which they have supplied it. The plan they have adopted is an excellent one; and as to its execution there is very much to praise. A history of English observatories and their work could not be otherwise than somewhat unequal in its execution; it would probably be so to some extent even in native hands; to a foreigner, who must, generally speaking, depend upon communicated information, the difficulty would be insuperable; and to this cause we may evidently refer the omission of some finely appointed private observatories, such as those of the Rev. H. C. Key, with its 18-inch silvered speculum, of Mr. Bird, the Rev. E. L. Berthon, Capt. Noble, Mr. Neison, Mr. Barnes, and many others. It is, in fact, in these private "telescope-houses" that England is so rich, as was formerly remarked in substance to the present writer by M. Léon Foucault, and it is through their work that much of the physical astronomy of the day has been advanced to its present position. But this is exactly what would escape the notice of any but ourselves, and even the generality of ourselves; and in this respect there is, of course, a good deal of deficiency in the work which cannot well be blamed. But great pains have evidently been taken to insure correctness, and to impart knowledge which to many among ourselves will have all the interest of novelty; and this has been done, for the most part, as far as we can judge, in a very satisfactory way.

The French language is now so generally understood among us that a translation is perhaps not required; but should it be undertaken, or should the authors, as we hope, be encouraged to send forth another impression, we would request permission to offer a few suggestions. The Bedford Catalogue, which has had so marked an influence on English astronomy, would well come in for a share of notice: the names of the opticians, whose work is described—which are seldom given, and perhaps not always correctly—might be supplied with advantage; several orthographical slips, and one considerable error in the little map, might be rectified. With these improvements, and some difference in the arrangement and appropriation of the very pretty illustrations, this charming little volume, even now greatly to be commended, would meet our expectations in every way. T. W. W.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Quantitative Relations of Cause and Effect

AFTER Mr. Spencer has implied that he will not himself continue the controversy further, Mr. Hayward, in his last letter, has confused the issues by misstating Mr. Spencer's position. In the circumstances, perhaps, it will not be improper for me, as one familiar with Mr. Spencer's psychological doctrines, to rectify Mr. Hayward's error and explain that which he misapprehends.

The cue may be taken from an experience described in Mr. Spencer's "Principles of Psychology" (§ 468, note), where it is shown that when with one hand we pull the other, we have in the feeling of tension produced in the limb pulled a measure of the reaction that is equivalent to the action of the other limb. Both terms of the relation of cause and effect are in this case present to consciousness as muscular tensions, which are our symbols of forces in general. While no motion is produced they are felt to be equal, so far as the sensations can serve to measure equality; and when excess of tension is felt in the one arm, motion is experienced in the other. Here, as in the examples about to be given, the relation between cause and effect, though numerically indefinite, is definite in the respect that every additional increment of cause produces an additional increment of effect; and it is out of this and similar experiences that the idea of the relation of proportionality grows and becomes organic

A child, when biting its food, discovers that the harder he bites the deeper is the indentation; in other words, that the more force applied, the greater the effect. If he tears an object with his teeth, he finds that the more he pulls the more the thing yields. Let him press against something soft, as his own person, or his clothes, or a lump of clay, and he sees that the part or object pressed yields little or much, according to the amount of the muscular strain. He can bend a stick, the more completely the more force he applies. Any elastic object, as a piece of india-rubber, or a catapult, can be stretched the farther the harder he pulls. If he tries to push a small body, there is little resistance and it is easy to move; but he finds that a big body presents greater resistance and is harder to move. The experience is precisely similar if he attempts to lift a big body and a little one; or if he raises a limb, with or without any object attached to it. He throws a stone: if it is light, little exertion propels it a considerable distance; if very heavy, great exertion only a short distance. So, also, if he *jumps, a slight effort raises* him to a short height, a greater effort to a greater height. By blowing with his mouth he sees that he can move small objects, or the surface of his morning's milk, gently or violently according as the blast is weak or strong. And it is the same with sounds: with a slight strain on the vocal organs he produces a murmur; with great strain he can raise a shout.

The experiences these propositions record all implicate the same consciousness—the notion of proportionality between force applied and result produced; and it is out of this latent consciousness that the axiom of the perfect quantitative equivalence of the relations between cause and effect is evolved. To show how rigorous, how irreversible, this consciousness becomes, take a boy and suggest to him the following statements:—Can he not break a string he has, by pulling? tell him to double it, and then he will break it. He cannot bend or break a particular stick: let him make less effort and he will succeed. He is unable to raise a heavy weight: tell him he errs by using too much force. He can't push over a small chest: he will find it easier to upset a larger one. By blowing hard he cannot move a given object: if he blows lightly he will move it. By great exertion he cannot make himself audible at a distance: but he will make himself heard with less exertion at a greater distance. Tell him to do all or any of these, and of course he fails. The propositions are unthinkable, and their unthinkableness shows that the consciousness which yields them is irreversible. These, then, are preconceptions, properly so called, which have grown unconsciously out of the earliest experiences, beginning with those of the sucking infant, are perpetually confirmed by fresh experiences, and have at last become organised in the mental structure.

It is not, however, any such experiences which Mr. Hayward adduces to exemplify organic preconceptions. He asserts that his "principal 'exemplification of unconsciously-formed preconceptions' was of Mr. Spencer's own choosing, namely, Newton's 'Second Law of Motion.'" This is an error: Mr. Spencer gave *no examples of unconsciously-formed preconceptions. If* Mr. Hayward will refer to Mr. Spencer's letter in NATURE, vol. ix. p. 462, he will find that Mr. Spencer has described the unconsciously-formed notion of the relation between cause and effect in general terms, and without example or illustration. In his last letter he simply named the relation between muscular tensions and their effects. Probably he expected Mr. Hayward to seize his meaning without any specific example.

The examples given by Mr. Spencer were examples of *consciously*-formed conceptions based on this *unconsciously*-formed preconception acquired during childhood and boyhood. Mr. Spencer gave three instances into which this preconception tacitly enters: one chemical, another relating to the melting of ice, and a third to the process of weighing. The last is the only one into which the relation between force and motion can be supposed to enter. But the consciously-formed conception that double weights will balance double masses, and so on, is not one into which there really enters any relation between force and motion. The notion of weighing is that of the equal forces of equal masses at the ends of equal levers. So long as there is motion, there cannot be equilibrium. The idea of motion is excluded when weighing is complete.

When Mr. Hayward says that Mr. Spencer has taken Newton's "Second Law of Motion" as an example of unconsciously-formed preconceptions, he utterly misapprehends Mr. Spencer's meaning. The "Second Law of Motion" is one of those developed *conceptions* derived from the organic *preconceptions* above described.

Mr. Spencer's argument appears to be briefly this:—1. There are numberless experiences unconsciously acquired and unconsciously accumulated during the early life of the individual (in harmony with the acquisitions of all ancestral individuals) which yield the preconception, long anteceding anything like conscious physical experiments, that physical causes and effects vary together quantitatively. This is gained from all orders of physical experiences, and forms a universal preconception respecting them, which the physicist or other man of Science brings with him to his experiments.

2. Mr. Spencer showed in three cases—chemical, physical, and mechanical—that this preconception, so brought, was tacitly involved in the conception which the experimenter drew from the results of his experiments.

3. Having indicated this universal preconception, and illustrated its presence in these special conceptions, Mr. Spencer goes on to say that it is involved also in the special conception of the relation between force and motion, as formulated in the "Second Law of Motion." He asserts that this is simply one case out of the numberless cases in which all these conscious-reasoned conclusions rest upon the unconsciously-formed conclusions that precede reasoning. Mr. Spencer alleges that as it has become impossible for a boy to think that by a smaller effort he can jump higher, and for a shopman to think that smaller weights will outbalance greater quantities, and for the physicist to think that he will get increased effects from diminished causes, so it is impossible to think that "alteration of motion" is not "proportional to the motive force impressed." And he maintains that this is, in fact, a latent implication of unconsciously organised experiences just as much as those which the experimenter necessarily postulates.

I may add that if mathematics included in its range the connection between objective phenomena and the answering subjective states, this question would be one for mathematicians; but at present it is, as it seems to me, a question pertaining to the psychological basis of inductive logic. JAMES COLLIER

Bayswater, May 18

The Glacial Period

I THINK there are but few points in Mr. Belt's letter ("The Glacial Period," NATURE, vol. x. p. 25) to which Geologists who have devoted much attention to the ice action will not take exception. May I be allowed to call attention to one or two?

1. I do not believe that there is evidence, which anyone accustomed to glacier "spoor" would admit, of an extension of the ice-cap so far south as the Thames valley.

2. It is in the highest degree improbable that the shells on Moel Tryfaen should have been scooped out of the bed of the North Sea by moving ice and transported to their present position. Apart from the difficulties of a glacier thus walking so far up-hill, and of shells having escaped utter smashing in this uncomfortable mode of transport, Mr. Belt has forgotten that Wales was a centre from which radiated glaciers, and at one time an ice-sheet, which surely would have warded off from its own hills the northern intruder. What evidence is there that the ice-sheet ever followed its path? All that I know points to local glaciation.

3. Mr. Belt forgets that the various sea-marks are often at very different heights above the present water-level—as is so well shown in Scandinavia—and that no lowering of the water will explain this. The height of even 600 ft. which he claims is one that rests on many assumptions and but little confidence can be placed on the numerical results.

It would be easy to discuss many other questions which he raises, but this would occupy far too much space. My present purpose is not so much to do this, as to utter a protest against such a portentous development of a theory which has for some time past been assuming nightmare proportions.

St. John's College, Cambridge, May 19 T. G. BONNEY

Lakes with two Outfalls

IT is quite possible that I am wrong in my memory of the Nystuen watershed; and as Prof. Stanley Jevons examined the place critically, I can have no doubt that I am so. I passed merely as a traveller, and described what I had seen, from a memory, not specially sharpened by a knowledge of the importance of the point, at the time the observation was made. I know well what tricks one's memory plays under such circumstances, particularly when one has been rambling over many similar localities; and my letter indicated that I was in doubt as to the particular lake which gave the double outfall. I passed, too, just after much heavy rain, and it is possible that the boggy bottom which Mr. Jevons describes was temporarily converted into the lake, which deceived me. I may add, that both the guide who brought me over the mountains from Aardal, and the Skydsgudt who took me to Skogstad, confirmed the double outfall.

My object, however, in writing, was chiefly to draw attention to Norway, as offering an admirable field for the settlement of the controversy, without going to the wilds of America. If there be such phenomena, and I believe there are, they may assuredly be looked for in that land of hard granite rock, mountain plateaux, and innumerable watersheds of all sizes and varieties, and if the hundreds of educated Englishmen who go there every year be only impressed with the importance of accurate observations, the point may soon be settled.

Certainly I agree that Colonel Greenwood, who has kindly favoured me with a most interesting letter of advice, has done excellent service by his quite justifiable incredulity, and I shall myself be content to have made a mistake, if by it I shall be the cause of greater accuracy in others. W. B. THELWALL

27, Burghley Road

Glass Cells with Parallel Sides

I SEND you a brief description of a method I have recently employed for rapidly fitting up glass cells with parallel sides, believing that it may be of interest to your readers.

A piece of indiarubber tubing (or of solid rubber) bent into a semicircular form is placed between two equal-sized rectangular plates of glass, the ends of the tube terminating at the upper edges of the glass plates; the plates are then held together by passing two strong indiarubber rings over their ends. If the rings are of such a size as to exert the requisite compression a semicircular water-tight cell is thus obtained, which can be taken to pieces and cleansed with the greatest ease.

A trough so made served well to exhibit with an ordinary magic-lantern the experiments described on pp. 173 and 174 in Tyndall's "Heat a Mode of Motion," and smaller cells suitably fitted with platinum wires, and held in the wooden frame of an ordinary lantern-slide, enabled the galvanic decomposition of acidulated water and of saline solutions to be thrown upon a screen and thus rendered visible to a large audience.

Queenwood College, Hants. FRANK CLOWES

Brilliant Meteor

WHEN nearing Holyhead at 0.50 A.M. on the 19th inst. the most brilliant meteor I have ever seen passed slowly across the heavens. It formed near Antares, remained stationary for two or three seconds, and then slowly moved to the northward, disappearing in the Great Bear. Throughout, the soft green light showed every portion of the hull and rigging with as much distinctness as a number of pyrotechnic fires could have done. The shape was that of an elongated ellipse, slightly contracted at one end, with the major axis of the apparent diameter of the sun. A short time before it disappeared six sparks as large as Jupiter were discharged from the southern end, and I thought a crackling sound followed.

Celtic, May 20 WM. W. KIDDLE

THE U.S. ACADEMY OF SCIENCE

SESSION AT WASHINGTON

THE U.S. National Academy of Science held its meetings this year at the Smithsonian Institution, the venerable Prof. Henry, secretary of the Institution, presiding over the deliberations of the Academy. The session commenced on April 21 and lasted four days. By favour of the scientific editor of the *New York Tribune* we have obtained advanced reports. Our space permits us to give only the titles of the more important papers; but as Dr. Brown-Séquard's paper on the functions of the brain is of very great interest in reference to recent researches on the subject, we shall give a longish abstract of it.

Among the papers of importance were the following:—Dr. J. L. Le Conte read a paper On a classification of the *Rhynchophorous coleoptera*. Prof. Fairman Rogers described an automaton to play tit-tat-too, which he had constructed.

Prof. A. M. Mayer read three papers, one entitled "Suggestions as to the functions of the spiral scalæ of the Cochlea, leading to an hypothesis of the mechanism of audition." The second paper was headed "Abstract of a research in the determination of the law connecting the pitch of a sound with the duration of its residual sensation, and on the determination of the number of beats—throughout the range of musical sounds—which produce the most dissonant sensations; with applications of these laws to the fundamental facts of musical harmony, and to various phenomena in the physiology of audition." Prof. Mayer gave the particulars of a series of experiments by which it was ascertained what must be the frequency of successive sounds to have them blend indistinguishably together. The third described a series of experiments on the reflection of sound from flames and heated gases.

Prof. Simon Newcomb, the astronomer in charge of the Washington Observatory, gave a description of the preparations in America for the observation of the coming transit of Venus. These are most thorough and complete.

Prof. Wolcott Gibbs, of Harvard University, read a paper On metamerism in organic chemistry. Prof. Gibbs has discovered six metameric bodies, a seventh having been discovered by Prof. Erdmann.

Comparative velocity of light in air and in vacuo, by Prof. Stephen Alexander of Princeton College. This brief paper merely contained a few interesting suggestions on a small correction of the velocity of light as deduced from experiment.

In accordance with the undulatory theory the velocity of light must be less in atmospheric air than in vacuo, in the inverse ratio of the index of refraction of atmospheric air to 1; that is, as 1 to 1·000294. The velocity then as ascertained by experiment under the air should be increased by just about 0·000294 of itself to be equal to that in vacuo; *i.e.* to the extent, almost exactly, of 55 miles per second; a very small quantity indeed in comparison with the whole velocity of 185,000 miles per second; and yet, small as it is—and so small as to be below the limits of error of the experiments in question—it is yet very closely equal to three times the velocity of the earth in its orbit.

It is an outstanding excess, and no more, with which we often have to do, as, for example, in the measurement of temperature; but the scale on which those differences sometimes present themselves makes them, small as they may be in their original comparison, grand in comparison with ordinary standards. Prof. Alexander was not aware that anything has yet been put forward elsewhere on this subject.

Prof. Hayden gave a general account of the scientific explorations and survey in the West in which he has been engaged. With the results of these our readers are already pretty familiar.

In a paper On the laws of cyclones, by Prof. William Ferrel of the Coast Survey, the author gave a *résumé* of our knowledge on the subject and of some of the theories which have been advanced.

Dr. E. Bessels read a paper entitled "The History of Smith's Sound from a Geographical and Geological Point of View, and some other General Results of the *Polaris* Expedition." Dr. Bessels thinks that Smith's Sound must be regarded as the best of the three gateways to the pole. The land found between 81° and 82° seems to Dr. Bessels to be of great importance in demonstrating that Greenland has been separated from the continent in a south-north direction. Dr. Bessels stated several important facts bearing on the rising and sinking of the land on the Greenland coast.

Prof. Simon Newcomb gave a description of the great telescope at Washington; and a paper by Prof. S. Alexander of Princeton, N.J., On three of Jupiter's satellites, was read.

Prof. J. S. Newberry of Columbia College, New York, read a paper On Lower Silurian fossils. This was a memoir on the so-called land plants of the Lower Silurian in Ohio. Taking all the characters of these interesting fossils into consideration, Prof. Newberry is disposed to regard them as casts of the stems of fucoids.

The following papers were read by title only:—A memoir on the zodiacal light, by Prof. S. Alexander; On some points in Mallet's theory of vulcanicity, by Prof. E. W. Hilgard; The polarisation of the zodiacal light, by Prof. A. W. Wright. An exceedingly interesting and valuable paper on the mode of formation of the earth, its condition as to interior fluidity, and the probable limits within which it was reduced from a fluid state to its present condition, under the title of "A Criticism on the Contractional Hypothesis of the Earth's Surface Changes," was read by Capt. Clarence Dutton of the Ordnance Corps, U.S.A.

Dr. Brown-Séquard began his paper On the pretended localisation of the mental and the sensorial functions of the brain, by saying that the subject has been rendered more difficult by assumptions of physiologists upon insufficient data. Among the views which have been recently brought forward upon the localisation of nervous power in certain parts of the brain, there are two of importance: one relates to the seat of power actuating muscles, and the other is as to the seat of sensation for different nerves. In the latter particular, after noticing several exploded theories, some still pertinaciously adhered to by physicians, Dr. Brown-Séquard reviewed especially the assumption in respect to the seat of power for speech:—

"Let us consider the question of the locality of the intelligence of the brain. Most physiologists are agreed that this is the grey matter of the upper parts of the brain. But the method of communication is still open to research." (Here the lecturer went to the blackboard and drew a figure somewhat like a sheaf of wheat without a band around it; the stalks representing the nerves, the heads of wheat representing the cells) "Now you may subtract from this, by disease or otherwise, say the upper third, and still you have the nerves and the nerve cells, and the processes can be carried on; but in the progress of such destruction downward there would eventually be reached a point where the functions of the brain could no longer exist. This view would explain the facts as we find them. But there is no case on record where the grey matter on both sides of the brain has been destroyed without the loss of intelligence, and we must regard the grey matter as the seat of the intelligence. But vast portions may be removed before the loss of intelligence becomes apparent. This I have myself tested and proved by vivisection of the lower animals.

"Now, in respect to the locality of the power of speech. It has been said that the loss of brain power to express ideas in speech was located in a certain part of the brain. This affection is called aphonia or aphasia. There are three modes of expressing ideas—by speech, by gesture, and by writing. It is with the first only that we are concerned. Some very bold theorists have tried to locate all these powers in a particular part of the brain. Let us confine ourselves to facts. Dr. Broca of Paris has advanced the view that a certain small portion of some of the convolutions of the brain holds the power of speech. I admit that facts seemed to favour this view. But we find that there is no relation between the degree of aphasia and the extent of the disease of that part, and there are cases where the destruction of those convolutions is very great, and the injury to speech very little. Secondly, we find that disease may have overtaken the anterior, the posterior, and the middle lobes of the brain, the particular convolution supposed to involve speech not being affected, and yet there is marked aphasia. Now, is some one of these lobes the locality of the power of speech? Such would be the reasoning of my opponents. We should be obliged to concede that in some persons the faculty of speech existed in one part of the brain, in some in another, in others another, and so on *ad infinitum*. This is a *reductio ad absurdum*.

"There is the case of the paralysis of the insane, where the grey matter may be diseased on both sides of the brain. In these cases the power of speech does not seem to be involved. There are cases of aphasia where the diseased person has had the power of speech restored during delirium. The speech is coherent though the sense may not be. It is evident, then, that the faculty of speech is not actually lost in such cases; and yet we find that the third frontal convolution is actually diseased in those aphasiacs who talk in their delirium. But the most decisive argument is found in the cases that I have seen, where the third frontal convolution, the alleged organ of speech, has been destroyed, and yet the patients have not lost the power of speech. Therefore the theory is itself destroyed. There are fifty cases on record to show that the question of right-handedness or left-handedness does not apply in the considerations." The lecturer here cited cases of Jacmet of Montpelier and Mr. Prescott-Hewitt of London. In the latter case the patient had suffered a destruction of that part of the brain for twenty years, and yet for twenty years had spoken.

"We shall now take up the question of the localisation of motion in certain parts of the brain. I am surprised at the avidity with which a certain series of facts has been accepted as proof of this theory in England. A very eminent man, of whom I should not like to say anything severe, my friend Prof. Carpenter, has accepted those views. I may say that all England has accepted them. Prof. Huxley, indeed, has written me, that he only accepted this view in part, but I cannot see how he can accept a part without accepting the whole, where even the part is incorrect. The famous experiments of Dr. Ferrier, of Guy's Hospital, must here be considered. As you will see, they are not, however, conclusive. By the application of galvanism to certain parts of the brain of animals, he produced certain movements. When we do not stop to think, this would seem to prove that there are in the brain certain centres of movement governing certain parts. But it is only a semblance. A part of the facts are taken for the whole. We should know all the series before we adopt the conclusions. Let us examine the other facts.

"It is perfectly well known that the cutting away of a large portion of the brain does not produce the least alteration of voluntary movement any where. Suppose that part of the brain, say the anterior lobe, being excited by galvanism, produces a movement in the anterior limb; now suppose that part of the brain is cut away, then the anterior limb should be paralysed, for its voluntary movement is gone. Admitting that the other half of the brain should supply the place of the missing part, let us take that away also; then certainly there should be a paralysis of the anterior limbs. But there is not. This should be sufficient to invalidate the conclusions of Dr. Ferrier. But there are abundant pathological facts of this nature proving the fact beyond question. And then there are the cases of recovery from paralysis. There is no such localisation of power as Dr. Ferrier has assumed. If galvanism be applied to the severed leg of the frog the leg will jump although there is no brain power in the question.

"What should have been done was to have cut the connection of parts, so that a general effect should not have been propagated throughout the brain by the application of galvanism to a part. This would be the *experimentum crucis*. My friend Dr. Dupré of Paris has made this experiment. I made it also, before he did, but he published his before mine. But there are many other facts almost equally impressive in their character which may be cited. We find many cases where the lesion of part of the brain produces paralysis on the same side of the body, and not on the opposite side, as in the majority of cases is the rule. There is a case recorded where a ball passed directly through the brain, and it produced paralysis on the right side, instead of the corresponding side." Here Dr. Brown-Séquard objected to having a certain class of brain affections named after him, stating that diseases should be named from their distinctive features, and not after physicians.

Dr. Brown-Séquard then applied a similar course of reasoning to the localisation of sensation in specific parts of the brain, concluding by stating that it is evident we cannot locate the centres of either sensation or motion in specific parts of the nervous system.

THE LONG PERUVIAN SKULL

I WISH to place before comparative anatomists and anthropologists a question which has been encumbered by some misleading inaccuracies, in a recent communication by Dr. J. Barnard Davis to the Anthropological Institute, ("On Ancient Peruvian Skulls" Journ. Anthropol. Inst., vol. iii., p. 94). So early as 1857, in communications to the British Association, and to the American Association for the Advancement of Science, I showed, in opposition to the views of Dr. Morton, and of all American ethnologists up to that date, that a dolichocephalic type of head is characteristic of certain widely diffused American races. At a later date I set forth, in "Prehistoric Man," my reasons for believing that this, which is now universally acknowledged as true in general, may be specifically asserted of the ancient Peruvians. This latter proposition Dr. Davis undertakes to refute; it is not a mere matter of personal controversy, but a question of some ethnical significance. As a Canadian, I lie outside of the charmed circles of home science and criticism, and only receive tardy news even of such communications as this, in which I have a personal interest.

Dr. Davis has not himself had an opportunity of examining the evidence on which my opinion was formed; and, in the communication above referred to, shows that he fails to appreciate its nature or true bearing. He says, Dr. Wilson's view, "which is that the dolichocephalic Peruvian skulls are of natural form, was combated in the 'Thesaurus Craniorum.' Since that book was printed, I have received ample and satisfactory evidence as to the truth of the proposition that the long skulls owe their quality to artificial means. By the politeness of Dr. J. Aitken Meigs, of Philadelphia, I have obtained two Peruvian skulls which at one period belonged to Dr. Morton's collection, as a specimen of each kind. One of these is brachycephalic, the other is dolichocephalic, but they both present distinct traces of artificial distortion. *This fact is conclusive.*" So says Dr. Davis. But conclusive of what? So far as I can see, it is simply conclusive as to the fact that both skulls have been artificially distorted. He then quotes Professor Wymann, of Boston, who, after an examination of the specimens referred to by me, settles the question thus summarily: "The upshot of the whole is, the crania do not confirm Dr. Wilson's statement. One of Dr. Wilson's points—in fact it is his chief point—is, that *skulls are natural because they are symmetrical;* and that it is next to impossible that a distorted skull should be other than unsymmetrical."

The thing I find most conclusive in all this is, that Dr. Davis and his correspondent both accredit me with inferences or opinions of their own, utterly inconsistent with my published views. So far am I from affirming "skulls are natural because they are symmetrical," that when my two critics have leisure to extend their reading to pp. 500-512 of the volume they refer to ("Prehistoric Man"), they will find many natural causes specified as tending to modify and distort the human skull. They will also find in the notes reference to papers in the *Canadian Journal,* and elsewhere, in which various aspects of this question have been repeatedly discussed. Dr. Davis has, I believe, received copies of all of those from myself; but, at any rate, there is one which can scarcely have escaped his attention—"On the Physical Characteristics of the Ancient and Modern Celt." It was published in the *Canadian Journal* in 1864, reprinted in the *Anthropological Journal* soon after, and became the subject of a good deal of reference in the famous copyright action of "Pike *v.* Nicholas." In this the explicit statement is repeated: "The normal human head may be assumed to present a perfect correspondence in its two hemispheres; but very slight investigation will suffice to convince the observer that *few living examples satisfy the requirements of such a theoretical standard.* Not only is inequality in the two sides of frequent occurrence, but *a perfectly symmetrical head is the exception rather than the rule.*" There is no possibility of mistaking the opinion thus expressed. It was published by me so long ago as 1862 (*Can. Journ.* vii. 414), and is repeated in substance in the very work from which Drs. Davis and Wymann profess to derive their absolutely contradictory dictum as "one of Dr. Wilson's points—in fact his chief point!"

But over and above all this, in the previous paper results derived from a careful study of eleven hundred and four English and French head-forms are set forth with this conclusion: "It thus appears that the tendency to unsymmetrical deformity is nearly as three to one; and that in the abnormal head the tendency towards excess of development towards the left is upwards of two to one." This tendency, it is further added, is more decidedly manifest in the brachycephalic than in the dolichocephalic head (*vid. Anthropol. Journ.* vol. iii. p. 82). The views thus repeatedly set forth, and supported by such proofs, are certainly not open to any charge of ambiguity. It is somewhat amusing, therefore, to find two such high authorities as Dr. Davis and his Boston correspondent summarising the whole, in this off-hand fashion, in a communication to a scientific body: "The upshot of the whole is," that, according to Dr. Wilson, "the skulls are natural because they are symmetrical, and that it is next to impossible that a distorted skull should be other than unsymmetrical."

By what process such opinions have been arrived at, and then accredited to me, I need not attempt to guess; but one thing unaccountably overlooked is the distinction on which I insist, between undesigned natural deformation, traceable to such simple causes as the one-sided pressure of the mother's breast, of the cradle-board, &c., and purposed modifications of the head, such as those practised at the present day among the Flatheads on the Columbia river. Three points on which I have insisted, not without evidence in their support, are: That the shape of the human head may not only be designedly altered by artificial means; but that it is much more frequently modified undesignedly, and rendered strikingly unsymmetrical, in infancy; while a third source, that of posthumous distortion, has also to be kept in view.

So far as to the general question. The specific one sought to be determined is the universality of a brachycephalic Peruvian type of head; or, as I have asserted, the occurrence of well-defined dolichocephalic heads in ancient Peruvian cemeteries. Dr. Davis informs the Anthropological Institute that my view was combated by him in his "Thesaurus Craniorum" (1867), and indeed it is with a view to the substantiation of "the criticisms of Dr. Wilson's statements in the 'Thesaurus,'" p. 246, that Dr. Wymann's "upshot of the whole" is produced. As one of the subscribers to Dr. Davis's valuable Catalogue, as well as a contributor to his collection of crania, I am familiar with the work, and with the pages specially set apart for my correction. I have had it, indeed, for years in my possession, without thinking that it needed refutation. I recommend any readers interested in the question to turn to the aforesaid p. 246, and read the curious narrative of Dr. Davis's conversion, in consequence of the receipt of a "skull next to unique in Europe," which belongs to "the long-headed race" of Peruvians, but yet is decidedly not long, or only long-headed "in a conventional sense," whatever that may mean.

I still believe it to be a fact, confirmed by my examination of examples referred to, that there is a well-defined dolichocephalic type of Peruvian cranium, although a brachycephalic type is the prevalent one. I have on three different occasions visited Philadelphia with the express object of studying the Morton collection there. One result has been to lead me to form a clear idea as to the source of Dr. Morton's later views. He had asserted the predominance of one uniform cranial type throughout the New World. "The long-headed Peruvians" were a disturbing element in this otherwise universal law. When therefore he turned to the examples in his own collection, and detected evidence of malformation by art in skulls which he had previously recognised as exceptions to his comprehensive theory, he welcomed the conclusion it suggested to his mind "that all these variously formed heads were originally of the same rounded shape." Dr. Davis informs us that he has obtained two Peruvian skulls formerly in Dr. Morton's collection, "a specimen of each kind," *i.e.* I presume, an occipitally flattened, and an elongated skull, both of the prevalent brachycephalic type. He has also the Titicaca skull already referred to, long, and yet not long, except "in a conventional sense." Possibly both Dr. Morton's and Dr. Davis's views are correct deductions from such premisses.

If a skull of the brachycephalic type, common to many American tribes (such as the Peruvian skull figured by Prof. Busk, vol. iii. pl. 7, "Journ. Anthropol. Inst."), is subjected to extreme depression of the frontal bone, with corresponding affection of the parieto-occipital region by the action of the cradle-board, such a form results as is shown in Fig. 78, p. 245, of Dr. Davis's "Thesaurus Craniorum." Examples of this are not rare. Here, if the length is measured from the projecting base of the frontal bone, immediately above the nasal suture, to the extreme posterior point, that will fall, not on the occipital bone, but nearly mid-way between the lamboidal and coronal sutures. Such a measurement is the actual extreme length of the modified skull; but if it is accepted as the true longitudinal diameter, without reference to the displacement of the points of measurement in the normal head, it is manifestly deceptive. It is, in fact, nearly equivalent to the substitution of the diagonal of a square for a diameter drawn parallel to its two sides. Such a skull, notwithstanding its actual length by measurement, is properly classed as brachycephalic. But take such a form as that which I have designated a "Peruvian dolichocephalic skull" ("Prehist. Man," 2nd ed. Fig. 50, p. 449). It is reproduced here; Fig. 1. Compare it with the above-cited example, in Dr. Davis's collection; or again compare the Peruvian child's dolichocephalic skull ("Prehist. Man," Fig 60, p. 451), also reproduced here, Fig. 3, with another juvenile skull, from the Peruvian cemetery of Santa, but of the brachycephalic type, as shown here, Fig. 2, reduced from Morton's "Crania Americana," pl. vii. The question is not, as Dr. Davis and Dr. Wymann would have it, whether the one is in its natural state, and the other artificially elongated? but whether it would be possible, by any elongation of the one, or abbreviation of the other, to reduce them to the same form? Compare the juvenile skull, Fig. 3, which is little, and probably not at all designedly, affected by art, with another of the same type, but purposely deformed by artificial means, Fig. 4. The same form is traceable in both, notwithstanding the modification of art. Both I conceive to be of the true dolichocephalic type; in contrast to the Santa skull, Fig. 2, which, whether or not affected by the parieto-occipital flattening so commonly resulting from the cradle-board, is no less obviously of the brachycephalic type; and could not be transformed into the other.

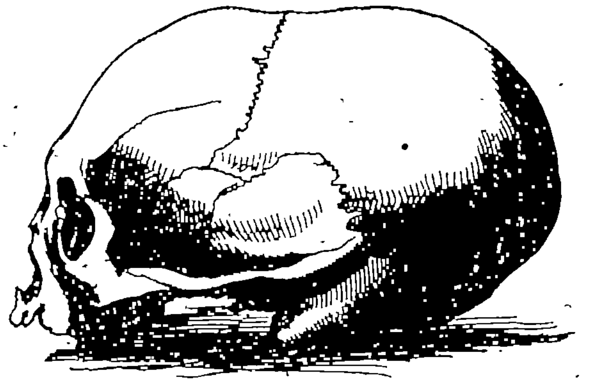


FIG. 1.—Peruvian Dolichocephalic Skull.

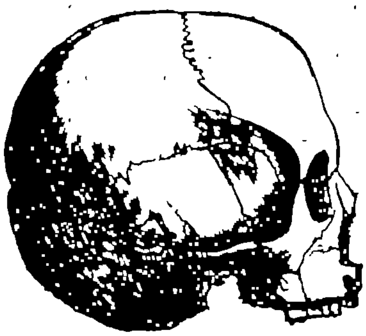


FIG 2.—Peruvian Child's Skull, Santa

The primary form of the skull, as determined, for example, by the relative proportion of the parietal bones, remains a factor to the last, however extreme may be the modifications superinduced by art. Only in the case of premature ossification of the sutures, consequent on the pressure applied in one direction, can this fail; though, no doubt in two approximate head-forms, the one only slightly dolichocephalic, and the other equally slightly brachycephalic, the original distinctive characteristics may escape observation in the modified skulls.

The question, then, turns mainly on this point—strangely ignored by Dr. Davis and his correspondent,—that a dolichocephalic and a brachycephalic skull are equally susceptible of distortion; but the same compression applied to the two types will beget different results;—will not, in any strongly marked example of either type, wholly efface the original character;—could not transform such a dolichocephalic skull as Fig. 1, into anything analogous to the elongated brachycephalic skull, Fig 78, of Dr. Davis's "Thesaurus."

I have necessarily left untouched various collateral points, for want of space; but enough has been said to show that what strikes Dr. Wymann as so "curious," and manifestly in his estimation so "conclusive" against me, in the projection of the occiput farther on the left than on the right side, is a feature I am very familiar with, in skulls which I should still call "natural," as distinguished from those designedly modified by art.

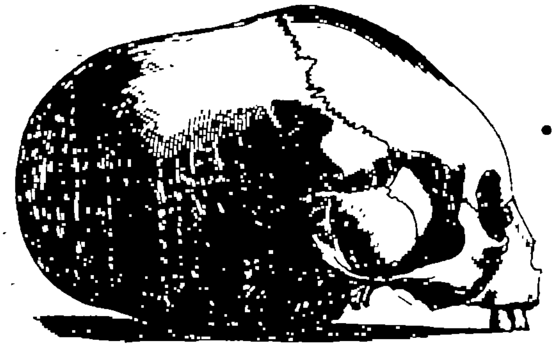


FIG 3.—Peruvian Child's Skull, Normal.

I shall refer only to two marked examples of this irregularity, in proof of such unsymmetrical forms existing among races in no way given to artificial cranial distortion. The first—a brachycephalic one—is "the skull of a young Greek," No. 1,354 of the Morton collection; a cast presented by Retzius. Dr. J. A. Meigs describes it minutely in his catalogue, p. 29, but takes no notice of its symmetry; although when viewed vertically it resembles some of the distorted Flathead skulls. The second—a dolichocephalic skull—Dr. Wymann will find alongside of the Peruvian skulls, No. 15 in the Warren Collection at Boston. It is that of a "Chinese," or was at any rate brought from China by Capt. Edes. It approximates in malformation to the "Hochbelaga skull," Fig. 67, "Prehist. Man," p. 501, as an example of posthumous distortion. But in this skull from China the sutures are close, with no trace of dislocation or other indications of posthumous modification of forms. Those are extreme examples; but I repeat what I have long ago asserted; that a perfectly symmetrical head is the exception, rather than the rule.

DANIEL WILSON

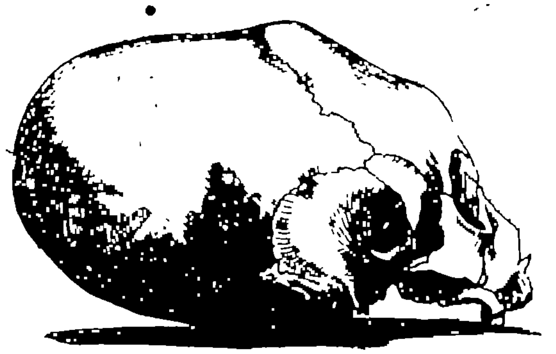


FIG 4.—Peruvian Child's Skull, Abnormal.

THE COMING TRANSIT OF VENUS[*]

V.

IT is probable that the observations of contact will be very materially supported by additional observations made with the double-image micrometer. This instrument was devised many years ago by Sir George Airy.[†] It is the most convenient eye-piece micrometer which can be used for measuring the distance between a pair of stars, or, as in the present case, between the limbs of the sun and Venus. The peculiarity of Airy's double-image micrometer consists in this, that one of the lenses forming an ordinary terrestrial eye-piece is divided in two, like the object-glass of a heliometer. The one half can be slid past the other, and the amount of displacement accurately measured by a divided circle, concentric with the screw which gives this motion. When the halves of this lens are relatively displaced, two images of the object are seen, as in the heliometer. If the distance between a pair of stars be the subject of measurement, the line of separation of the half-lenses is made to coincide with the line ioining the two stars. The screw is now turned in one direction, until the image of one star given by one half of the lens coincides with the image of the other star given by the other half of the lens. The amount of displacement is now read off. The halves of the lens are again brought to coincidence. The screw is now turned in the opposite direction, and a similar observation made. Knowing the value of the divisions on the divided circle, these two observations give us a means not only of determining the distance between the two stars, but also of fixing accurately the reading of the instrument when the half-lenses are in coincidence.

It is easy to see that after the internal contact at ingress, and before the internal contact at egress, measurements may thus be made of the distance of Venus from the sun's limb, from which the true time of contact may be deduced, just as in the Janssen photographic method.

But, besides, this double-image micrometer gives a means of estimating the true time of contact in a manner which may possibly be one of very great accuracy indeed. Consider the case of ingress two minutes before the time of true contact. From this time up to the actual contact the distance between the cusps, where the limbs of Venus and the sun meet, will diminish with very great rapidity. By turning the micrometer so that the line of junction of the half-lenses is in a line with the points of these two cusps, the distance between them may be very accurately measured. The observation may be repeated a number of times. The great rapidity with which these cusps approach, with a very slight motion of the planet, makes it probable that each of these observations will give the means of determining very closely the true time of contact.

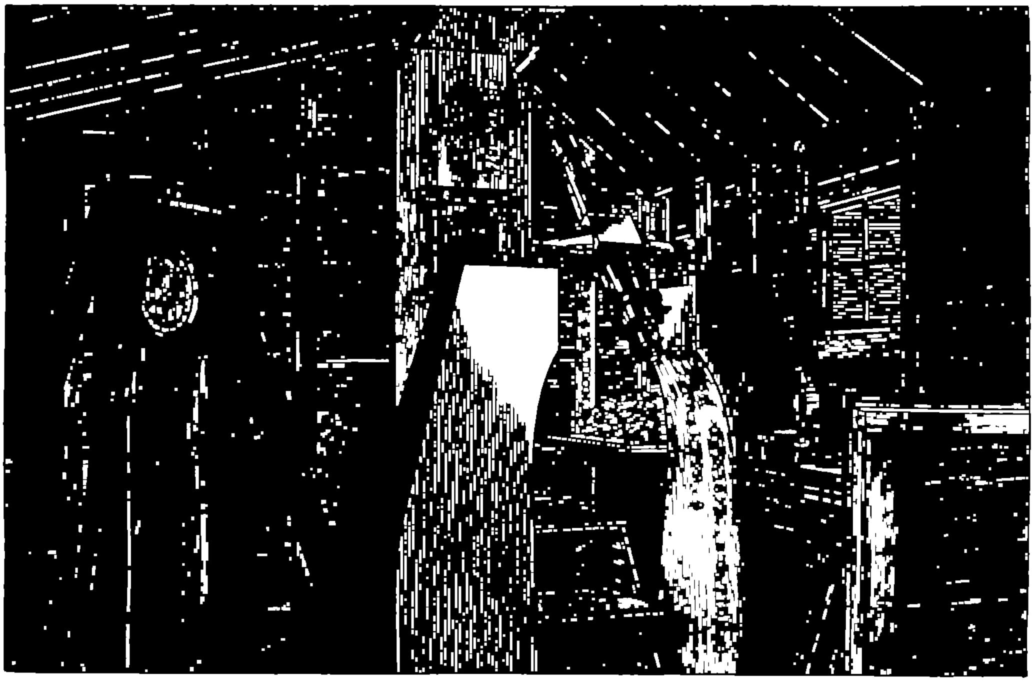


FIG 16 —The Transit-instrument of the British Expedition.

There are great difficulties connected with observations of the sun at such low altitudes as are required for the application of De l'Isle's and other methods. These will materially affect the definition of the cusps, and it is not certain that the micrometer method will give results so valuable as might have been anticipated.

But even in the eye-observation of contact the low altitude of the sun will be a serious drawback. This difficulty has been fully recognised by the Astronomer Royal, and, with the assistance of Mr. Simms, he has devised an ingenious eye-piece, which is likely largely to reduce the inconvenience.[*] The chief difficulty is, that at such low altitudes not only are the rays of light enormously refracted by the earth's atmosphere, but the colours are actually dispersed, as with a prism. Hence the definition cannot be perfect. The principle of the new eye-piece consists in employing a hemispherical lens for the one next the eye. The surface of this lens next to the eye is plane; and the lens can be moved, by means of a screw and slight spring, in a socket which is a portion of a sphere the same radius as the lens. By turning the screw, various inclinations can be given to the plane surface next the eye. But the curvature of the other surface remains the same, though a different portion of it is used. The practical result, then, of such an inclination of the lens in its socket is simply the introduction of a prism whose angle can be so varied as to correct totally the atmospheric dispersion.

---

[*] Continued from p. 30.

[†] Greenwich Observations, 1840.

[*] Monthly Notices of the R.A.S. vol. xxx. p. 58.

But in the case of photography the low altitude of the sun introduces a much more serious difficulty. The light has in this case to pass through a great length of the earth's atmosphere, in its lowest and densest regions. Much of the light is absorbed by the atmosphere, as is shown by the fact that the rising or setting sun may be gazed at with impunity. But further, it is found that of all the colours composing the sun's light, those which affect most powerfully a photographic plate are the most greedily absorbed. Hence it has been found at St. Petersburg that at mid-winter a photographic plate must be exposed to the sun 360 times as long as at the equinoxes, when the altitude of the sun is about 6° or 7°. This is a difficulty which cannot be surmounted except by exposing the plate a longer time than is desirable.

It has been already stated that considerable discrepancies in determining the times of contact might arise from observers noting different phenomena. The employment of the Model Transit of Venus ensures concordance among the observers of each nation; but all European observers will be much indebted to M. Struve, who has actually compared his own observations with those of the Russian, German, English, and French observers, so that comparisons will be possible between the observations of these different nations.

Everything being now prepared for observing as successfully as possible the actual phenomenon of contact, it remains to describe the means by which the time can be determined accurately. All clocks and watches are set and regulated by observations of the stars, or by comparison with other clocks so regulated. An astronomical clock counts the hours up to 24h. The clock is set to 0h. at the instant when a particular star passes the meridian. If then we have a means of determining the time when this happens, we can set our clock accurately to local time. But a star does not pass the meridian of Greenwich at the same time as it passes the meridian of a place having any other longitude. By the aid of a transit instrument the local time can be determined; but to determine actual Greenwich time at another place we must, as before stated, know accurately the longitude of that station. *These two things, the absolute time and the longitude, are so connected, that if we know the one, the other can be immediately deduced.*

The longitude may be determined in a variety of different ways. If the two places whose difference of longitude is to be determined be not very distant, a simple method may be employed. A rocket is sent up from some point between the two stations. An observer at each station notes the local time at which the rocket is seen to burst. The difference between these times gives the difference of longitude. A flash from a lamp or reflected sunlight may be similarly employed.

The absolute time (and consequently the longitude) can also be found by transporting chronometers from one station where it is known to another where it is not known. First-rate chronometers must be used, and a large number to check one another's errors. The main error of a chronometer is due to the influence of temperature on the momentum of the balance wheel and the strength of its spring. The Russians have of late years introduced with great success a method of secondary correction for this error. Along with the compensated chronometer at least one is sent without any compensation. The difference between this chronometer and others is a measure of the sum total of the temperatures to which they have been exposed; and by the aid of a table carefully drawn up from a number of observations, the amount of secondary correction necessary can be fairly estimated. It is said that the employment of this device is of the very greatest service. Ten well-tried chronometers, accompanied by a single uncompensated one, if carried between stations ten days apart (*e.g.* St. Petersburg and Casan) will, in one journey, give the longitude of an intermediate station (such as Moscow) correctly within $\frac{1}{10}$ of a second of time. By the aid of this contrivance chronometers may be employed, even for very long journeys, to determine the longitude. This method is quite new, and has not been tested by any nations except the Russians. The results obtained by them are, however, perfectly satisfactory. Theoretically the idea is almost perfect; the outstanding temperature error being the main fault of chronometers, and the employment of an additional chronometer uncompensated giving us a means of determining the amount of this error, the time deduced by this means ought to give very satisfactory results. There is but one objection to the method, which is only a partial one. After a series of alternately very hot days and very cold nights, the difference between the compensated and uncompensated chronometers might be the same as after the same period, with a tolerably uniform temperature; but the correction necessary in these two cases might be very different indeed. It is easy, however, to keep chronometers at a temperature which does not vary rapidly, and the experiments made by the Russians warrant us in saying that by the aid of this method longitudes may be determined, with very great accuracy indeed, in voyages of such length that the ordinary chronometric method would be unavailing, and that in every case where longitudes are required by the use of chronometers this method should be employed.

A third way of determining the absolute time is by the use of telegraphic signals. An operator at Greenwich may arrange to telegraph a signal to another at Alexandria at a certain definite time of day. If the transmission of the current from Greenwich to Alexandria were instantaneous the person at Alexandria would at that instant receive the exact time. But a current through a submarine cable is retarded. Suppose it to be retarded two seconds; the time received at Alexandria will be *too late* by two seconds. If now an operator at Alexandria telegraphs to Greenwich he will dispatch the signal two seconds *before* it reaches Greenwich. The longitudes determined by the two currents in opposite directions will therefore differ by four seconds. The mean of these values gives the true longitude, and half the difference between the two determinations is the time of transit of the currents. It is found, however, both from theory and experiment, that if there be a leak in the cable nearer to Greenwich than to Alexandria the current will pass more slowly in going to Alexandria than in the reverse direction. This difference, however, can never be very great.

Considerable differences have been found by the Americans to exist between comparative observations of longitude by the telegraphic method and by the lunar method, which will presently be described. The Americans rushed to the conclusion that the error existed in the lunar method. This is not necessarily so. The American system of telegraphing over long distances consists in using a *relay*. A relay is an arrangement to overcome the difficulty of sending a current through a long line. It is placed at an intermediate station. It consists essentially of an electro-magnet which attracts a piece of iron when a current which has originally been sent through the primary station passes through its coils. This attraction of a piece of iron makes contact with a new electric circuit with a separate battery, and so the current is passed on to the final station, or to a second relay. The piece of iron must move through a sensible distance before the second circuit is completed. It has hitherto been supposed that the time lost in employing a number of relays could be eliminated by sending the current in alternate directions as above described. This is certainly not the case. The time elapsing before contact is made by a relay depends upon the strength of the current. The strength of the current depends upon the length of the wire through which it is passing, and also upon the strength of the battery. Consider now the case of a relay at the junction of a long and short wire. The current passing through the long wire is weaker than the other. Hence if the current first pass through the short wire, the loss of time introduced by the relay is less than when the current is first sent through the long wire. For this reason the time taken by the current to pass in one direction is less than in the other direction. It appears then that the employment of a number of relays is injurious in longitude determinations, and if extraordinary precautions be not taken the resulting longitude will be erroneous. The same takes place with a submarine cable, with a leak near one end of it.

It must be noticed that in all the methods here described for determining the longitude, the local time must be accurately known. This is done by aid of a transit instrument as before described. One of the transit instruments of the British Expedition, in its wooden hut, is shown in Fig. 16.

Another class of method for determining the longitude depends upon the motions of the moon. It has already been stated that what we want is to know at some instant the absolute Greenwich time. If then we could get something analogous to a huge clock in the heavens which an observer at any part of the world could see we should be able to determine our longitude. The moon may be taken to represent the hand of such a clock, and the stars the hours and minutes. The moon is chosen in preference to the planets because she moves more rapidly among the stars. She moves around the earth, that is through 360°, in 27¼ days, or through 1° in two hours, or through one second of arc in two seconds of time. If then the tables in the *Nautical Almanac* predicting the place of the moon are absolutely correct, an observer by watching the instant at which she seems to come to the position of any star, and knowing from the tables the Greenwich time at which she reaches that position, receives an intimation of the absolute time from this gigantic celestial clock. Or, if there be no star, it will suffice to observe the time when the moon reaches any definite position among the stars. As a matter of fact the tables of the moon are by no means perfect; but this difficulty is overcome by the regular series of observations of the moon's place made at Greenwich on every possible occasion. Thus while the tables are sufficiently accurate to give the navigator a fair knowledge of his longitude, an observer in any country can, when convenient, compare his observations with those made at Greenwich, and so determine the longitude with great accuracy.

It is a fact of interest in connection with the present subject, that the transits of Venus will aid materially in perfecting the Lunar Tables. The motions of the moon are rendered irregular by the disturbing attraction of the sun. But we cannot determine with great accuracy either the amount or the direction of the sun's attraction upon the moon until we know accurately the sun's distance. Hence if we wish to be able to compute tables of the moon sufficiently correct for the exact determination of longitude, we must employ every means in our power to perfect our knowledge of the sun's distance.

Of the methods available for determining the moon's position, three will be employed in the coming transit. The first is by observing, with a powerful telescope, the exact time at which the moon extinguishes the light of a star in front of which it is passing. This is technically called an occultation of a star by the moon; and when the occultation is made by the non-illuminated portion of the moon the observation has great precision, and, the position of the star being known, is very valuable for determining longitude.

The second method is by observing, with a transit instrument, the exact time at which the moon passes the meridian, and by observing about the same time the transits of stars whose positions are well known.

The third method is by employing an instrument called an altitude-and-azimuth instrument, or shortly, an alt-azimuth. This instrument is shown in Fig. 17, and consists essentially of a telescope mounted upon two divided circles so arranged that the one shall give the altitude of an object towards which the telescope is pointing, while the other gives its azimuth or its angular distance from the meridian measured in a horizontal direction. An instrument of this class has long been employed at Greenwich with great success for determining the position of the moon when out of the meridian. It thus acts as a supplement to the transit-circle, of the utmost value in so cloudy a climate as our own. One disadvantage of this instrument is that the numerical reductions are extremely troublesome; but no trouble is too great in an observation of so much importance.

FIG. 17.—Portable Alt-azimuth Instrument.

It is not absolutely necessary that both altitude and azimuth should be observed. In equatorial regions the motion of the moon is chiefly in altitude, while in places of high latitude the motion is chiefly in azimuth. Hence among the English stations the vertical circles alone are provided for the stations within 30° of the equator, while at Rodriguez, Kerguelen's Island and New Zealand the azimuth circles are accurately divided. All these instruments have been well tested, and are found to be remarkably perfect. Not only the alt-azimuths but also most of the other instruments to be employed by the British have been constructed by Troughton and Simms; they have all been well tried, and the results have been so satisfactory that these makers deserve great credit for the help they have thus given to the success of the expeditions.

In all observations of the moon for determining the longitude there are of course numerous corrections which must be applied. Among these none is more important than the correction for the parallax of the moon.

RECAPITULATION.—In the case of every nation depending upon De l'Isle's method and in the case of every expedition when only one contact is observed, the longitude must be determined with very great accuracy. This can be done by any of the following methods :—

1. By rockets, or flashing signals.
2. By a trigonometrical survey.
3. By the aid of chronometers, in which it would be unwise to neglect the method lately introduced of adding to the chronometers one which is uncompensated.
4. The telegraphic method, in which it is not desirable to use relays, since very long lines with a Thomson's reflecting galvanometer will give good results, while the employment of relays is objectionable.
5. By observations of the moon's position which may be made by either of the three following methods :—
   - (α) By occultations of the moon.
   - (β) By transit observations of the moon and moon-culminating stars.
   - (γ) By aid of an alt-azimuth.

GEORGE FORBES

(*To be continued.*)

OCEAN CURRENTS

I OBSERVE that in NATURE, vol. ix. p. 423, Dr. Carpenter re-states and maintains his opinion that polar cold rather than equatorial heat is the *primum mobile* of his general oceanic circulation. In my papers in the *Philosophical Magazine* for Oct. 1871 and Feb. 1874 I have proved, I trust, to the satisfaction of any physicist who will be at the trouble to examine what I have written on the subject, that this notion is based upon a confusion of ideas in regard to the way in which difference of specific gravity produces motion. It is not my object at present to enter into any further discussion of this elementary matter; but I wish briefly to refer to a new and somewhat plausible-looking objection advanced in Dr. Carpenter's article against the views I advocate in reference to under-currents. The following is the paragraph to which I refer :—

"According to Mr. Croll's doctrine the whole of that vast mass of water in the North Atlantic, averaging, say, 1,500 fathoms in thickness and 3,600 miles in breadth, the temperature of which (from 40° downwards), as ascertained by the *Challenger* soundings, clearly shows it to be mainly derived from a polar source, is nothing else than *the reflux of the Gulf Stream.* Now, even if we suppose that the whole of this stream, as it passes Sandy Hook, were to go on into the closed Arctic basin, it would only force out an equivalent body of water. And as, on comparing the sectional areas of the two, I find that of the Gulf Stream to be about 1-900 that of the North Atlantic underflow; and as it is admitted that a large part of the Gulf Stream returns into the Mid-Atlantic circulation, only a branch of it going on to the north-east; the extreme improbability (may I not say impossibility?) that so vast a mass of water can be put in motion by what is by comparison a mere rivulet, the north-east motion of which as a distinct current has not been traced eastward of 30° W. long. seems still more obvious."

The objection seems to me to be based upon a series of misapprehensions: (1) that the mass of cold water 1,500 fathoms deep and 3,600 miles in breadth is in a state of motion towards the equator; (2) that it cannot be the reflux of the Gulf Stream, because its sectional area is 900 times greater than that of the Gulf Stream; (3) that the immense mass of water is, according to my views, set in motion by the Gulf Stream.

I shall consider these in their order: (1) That this immense mass of cold water came originally from the polar regions I of course admit, but that the whole is in a state of motion I certainly do not admit. There is no warrant whatever for any such assumption. According to Dr. Carpenter himself the heating power of the sun does not extend to any great depth below the surface; consequently there is nothing whatever to heat this mass but the heat coming through the earth's crust. But the amount of heat derived from this source is so trifling that an under-current from the Arctic regions far less in volume than that of the Gulf Stream would be quite sufficient to keep the mass at an ice-cold temperature. Taking the area of the North Atlantic between the equator and the tropic of Cancer, including also the Carribean Sea and the Gulf of Mexico, to be 7,700,000 square miles, and the rate at which internal heat passes through the earth's surface to be that assigned by Sir William Thomson, we find that the total quantity of heat derived from the earth's crust by the above area is equal to about 88 × 10^{11} foot pounds per day. But this amount is equal to only 1-894th of that conveyed by the Gulf Stream, on the supposition that each pound of water carries 19,300 foot pounds of heat. Consequently an under-current from the polar regions of not more than $\frac{1}{37}$ the volume of the Gulf Stream would suffice to keep the entire mass of water of that area within 1° of what it would be were there no heat derived from the crust of the earth. That is to say, were the water conveyed by the under-current at 32°, internal heat would not maintain the mass of the ocean in the above area at more than 33°. The entire area of the North Atlantic from the equator to the Arctic circle is somewhere about 16,000,000 square miles. An under-current of less than $\frac{1}{17}$ that of the Gulf Stream coming from the Arctic regions would therefore suffice to keep the entire North Atlantic basin filled with ice-cold water. In short, whatever theory we adopt regarding oceanic circulation, it follows equally as a necessary consequence that the entire mass of the ocean below the stratum heated by the sun's rays must consist of cold water. For if cold water be continually coming from the polar regions either in the form of under-currents or in the form of a general underflow, as Dr. Carpenter supposes, the entire under portion of the ocean must ultimately become occupied by cold water, for there is no source from which this influx of cold water can derive heat save from the earth's crust. But the amount thus derived is so trifling as to produce no sensible effect. For example, a polar under-current one-half the size of the Gulf Stream would be sufficient to keep the entire water of the globe (below the stratum heated by the sun's rays) at an ice-cold temperature. Internal heat would not be sufficient, under such circumstances, to maintain the mass 1° F. above the temperature it possessed when it left the polar regions.

(2) But suppose that this immense mass of cold water occupying the great depths of the ocean were, as Dr. Carpenter assumes it to be, in a state of constant motion towards the equator, and that its sectional area were 900 times that of the Gulf Stream, it would not therefore follow that the quantity of water passing through this large sectional area must be greater than that flowing through a sectional area of the Gulf Stream, for the quantity of water flowing through this large sectional area depends entirely on the rate of motion.

(3) I am wholly unable to understand how it could be supposed that this underflow, according to my view, is set in motion by the Gulf Stream, seeing that I have shown that the return under-current is as much due to the impulse of the wind as the Gulf Stream itself.

I am also wholly unable to comprehend how Dr. Carpenter should imagine that because the bottom temperature of the South Atlantic should happen to be lower, and the polar water to lie nearer to the surface in this ocean than in the North Atlantic, that therefore this proves the truth of his theory. This condition of matters is just as consistent with my theory as with his. When we consider the immense quantity of warm surface water which, as has been proved,* is being constantly transferred from the South into the North Atlantic—a quantity which to a large extent is compensated by cold currents from the Antarctic regions—we readily understand how the polar water comes nearer to the surface in the former ocean than in the latter. In fact the whole phenomena is just as easily explained upon the principle of under-currents as upon Dr. Carpenter's theory.

Dr. Carpenter lays considerable stress on the important fact established by the *Challenger* expedition, viz. that the great depths of the sea in equatorial regions are occupied by ice-cold water, while the portion heated by the sun's rays is simply a thin stratum at the surface. It seems to me that it would be difficult to find a fact more hostile to his theory than this. Were it not for this upper stratum of heated water there would be no difference between the equatorial and polar columns, and consequently nothing to produce motion. But the thinner this stratum is the less is the difference and the less there is to produce motion. I have been favoured by the Hydrographer to the Admiralty with a series of temperature soundings taken along the equator, and from these I find that to so small a depth does the super-heating extend that the surface of the ocean at the equator requires to stand only four and a half feet above that at the poles in order to the ocean being in perfect equilibrium. In this case if we suppose, in order to constant circulation, that the polar column is kept in excess of the equatorial by the weight of say two feet of water, there would then remain only a slope of two and a half feet between the equator and poles.

There is another point to which, with some reluctance, I am compelled to refer. Dr. Carpenter is continually representing that eminent physicists have adopted his theories while none of them share in my objections. I can assure Dr. Carpenter that such is not the case. Only a few weeks ago one of the most eminent mathematical physicists of the present day stated to me that no one familiar with the elements of physics and mechanics, who would be at the trouble to make himself acquainted with Dr. Carpenter's theories, could ever adopt them.

JAMES CROLL

---

* Phil. Mag. for March 1874, p. 170.

BIOLOGY AT CAMBRIDGE

ON the evening of Monday, 11th inst., Cambridge biologists mustered at least a hundred strong at the meeting of the Philosophical Society to hear a communication from Prof. Huxley, one of the honorary members of the Society, on the morphological conclusions to be drawn from the distribution of the cranial nerves, with especial reference to those of the seventh pair. Prof. C. B. Babington, F.R.S., president of the Society, occupied the chair. Prof. Huxley took occasion to refer in terms of the highest commendation to the researches of Stannius more than twenty years ago, on the morphological teaching to be derived from studying the distribution of nerves, and also spoke of the deductions drawn from nerve-supply by Gegenbaur, especially in his work on the "Skulls of Plagiostomous Fishes." Prof. Huxley sketched in considerable detail the distribution of the portio dura or seventh cranial nerve in man, and compared it with the homologous nerve in the frog, showing how the arrangements of branches, especially the course of the chorda tympani, which seemed anomalous in man, were a necessary consequence of perfectly obvious and natural arrangements in the lower vertebrates. He also demonstrated how the morphology of the parts might be learnt from such homologies; how a circuitous and apparently useless path taken by a nerve was full of meaning and instruction, and when studied in connection with facts of development and function would lead to an explanation which might be very much trusted. The relation of the tympano-eustachian tube to the bifurcation of the seventh nerve was dwelt upon, as leading to the identification of the comparatively small and simple auditory passage of the frog with the complex one of the mammal, and further to the homological identity of these passages with the spiracle of the Plagiostomes. The distribution of the fifth and seventh pairs of cranial nerves was held to agree with the view, suggested by development, that the trabecular arch is a pre-oral visceral arch, and that the pterygo-palatine is but an outgrowth of the mandibular arch.

The paper, which was illustrated by black-board drawing, with the professor's well-known aptitude, and which was a model of lucidity and careful reasoning, was loudly applauded. In a discussion which followed, Prof. Humphry drew attention to labours of his own having the object of showing the value of the teaching of nerve distribution. He acknowledged the strong case which was now made out in favour of the trabecular arch taking its position in the series of visceral arches, and thought that Prof. Parker's paper on the development of the pig's skull made it almost equally clear that the pterygo-palatine arch was similar in homology. It was also remarked that the same conclusions seemed deducible from Prof. Parker's paper on the development of the salmon, where the pterygo-palatine arch was distinct from the first and in all respects like the other visceral arches.

The practical class for the study of elementary biology, conducted by Dr. Michael Foster and Dr. Martin, is very successful this term. When thirty students entered last year the number was thought very large, and it was made up of men of several years who had previously had no opportunity of attending such a course. It was expected that a much smaller number would attend this year; but the large number of nearly forty have availed themselves of the course, and work proceeds in a most satisfactory and instructive fashion. Adequate superintendence is provided at all hours of the working day by the co-operation of four advanced students in addition to the lecturers. These are Messrs. P. H. Carpenter, Trinity College, A. M. Marshall, B.Sc., and Langley, St. John's College, and S. H. Vines, B. Sc., Christ's College.

G. T. BETTANY

NOTES

ON Tuesday, Sir Samuel Baker delivered the Rede lecture in the Senate House, Cambridge, before a numerous assemblage, which included all the leading men of the University in residence, and many ladies. The subject of the address was "Slavery," and Sir Samuel's narrative of his personal experiences in Africa was listened to with much interest.

IT is said to be in contemplation to confer honorary degrees at the Cambridge commencement upon Sir Bartle Frere, Sir Garnet Wolesley, Sir James Paget, and Prof. Helmholtz.

IT is stated that if the authorities of Owens College, Manchester, can show that they really require it, Government are prepared to make a considerable grant of money to the College.

THE Founder's Medal of the Royal Geographical Society has been granted to Dr. Schweinfurth, and the Victoria Medal to Col. P. E. Warburton, who recently succeeded in crossing the interior of Western Australia.

BY later advices from Australia we learn that Major Warburton accomplished exactly what he set out to do. He traversed the continent from the MacDonnell Ranges to the coast north of

Nickol Bay, passing over 800 or 900 miles of ground never before trodden by the foot of white man. The expedition has been useful only in a scientific point of view; the country for nearly the whole distance is utterly worthless. Barren, scrubby, and in the last degree wretched, the explorers had the utmost difficulty in forcing their way through. With poor food for the greater portion of their dreary journey, with water often scarce, and little game, the brave band were reduced to the utmost extremities. For three months they had nothing to live on but dried camels' flesh, and as much roots and bulbs as they were able to gather.

It is said that the king of Sweden has conferred upon Mr. Leigh Smith, the Arctic explorer, the Order of the Polar Star. Mr. Smith succeeded last spring, at his own expense, and with much difficulty, in rescuing the Swedish expedition, which had been caught by the ice in the preceding winter.

The Albert Gold Medal of the Society of Arts has been awarded for the present year to Dr. C. W. Siemens, F.R.S.

The German Emperor a few days ago at Wiesbaden, received Herr Rohlfs, the German explorer, who has just returned from the Lybian desert. It was by the Emperor's special command that the well-known traveller repaired to the palace and gave his Majesty an interesting account of his latest travels. The Emperor, as a further distinction, desired Herr Rohlfs to dine that day at the imperial table.

We are glad to learn that, in accordance with the wish expressed at the Meteorological Congress held at Vienna in 1873, a commission has been nominated by the Imperial Academy of Sciences at St. Petersburg and by the Imperial Ministry of Marine, to prepare a project for the establishment of a central office for Maritime Meteorology in Russia, including a system of meteorological telegraphy and storm warnings. Prof. H. Wild, Director of the Central Physical Observatory, and Capt. M. Rikatcheff, Assistant in the same establishment, are appointed members of the commission.

M. Prjewalsky, a staff-officer of the Russian army, is about to publish an account of a journey in which he has successively explored Dzungaria, Koukou Noor, and Moupin. Like Armand David (Nature, vol. x. p. 32), he brings back with him extensive collections. Insects hold a large place in both; those of Père David, said to be exceedingly interesting, have been presented to the Musée National, at Paris, where they have remained unnoticed by the French entomologists, one of whom says, that now "they will probably always remain unknown."

M. J. Liagre has been elected Perpetual Secretary of the Belgian Academy of Science, in succession to the late M. A. Quetelet.

A Geological excursion on a somewhat extended scale has been proposed, to those localities in the Swiss Alps which have become household words amongst those who have studied the changes of the earth's surface, and the action of ice and water more especially. A gentleman whose local knowledge is undoubted has been requested to act as cicerone to the party, and to deliver discourses upon the more interesting spots. He has accepted the first task, but wishes to secure the kind offices of an indigenous geologist for the second. It is hoped to arrange for a large party of ladies and gentlemen to start early in August and be absent for a month. This is the first time the interests of Science will be added to the enjoyments of a summer's holiday, with the exception of the short excursions near home of the Geologists' Association.

The President of the Institution of Civil Engineers and Mrs. Harrison held a reception on Tuesday evening in the western gallery of the International Exhibition, at which over two thousand guests were present. In addition to the picture galleries and rooms containing machinery in motion, the west quadrant was open, and in it were placed illustrations of recent scientific inventions specially lent for the evening. With the exception of Mr. Crook's experiments showing attraction and repulsion accompanying radiation, and Tisley and Spiller's compound pendulum apparatus, all were applications of scientific inventions to the wants of life, if wicked war may be included among our wants, for Sir W. Armstrong, and other firms, sent models of appliances for the hydraulic mounting of large guns, whereby they can be placed in position with ease. One of the most recent applications of electricity is to a self-recording "way-bill" of omnibuses. An apparatus brought out by Messrs. Whitehouse and Clark counts up once every minute the number of passengers in the omnibus and prints this number and the exact time in plain figures. Each seat is separate, and the weight of the passenger on the seat brings the wire from that seat in communication with the recorder. The instrument also records the speed of the omnibus at every moment of the journey, and shows the exact time of arrival and departure from each station. The cost is said to be but a few shillings a week, but it does away with the need of a time-keeper. A sample was exhibited of bills made May 15, in Liverpool, showing that the invention is practicable as well as ingenious. Nearly all other models were of docks, lighthouses, or railway appliances.

At a meeting of the Sedgwick Memorial Committee held at Cambridge on the 12th inst., the treasurers, Mr. Vansittart of Trinity, and Mr. Ewbank of Clare, announced that more than 10,000*l*. had been promised, of which 9,000*l*. had been received. The money is to be expended in the erection of a Geological Museum, to be called the Sedgwick Museum. After discussion it was agreed that the time had arrived when it is desirable that the University should take the subject into consideration. The chairman, Prof Humphry, was desired to communicate the resolution to the Vice-Chancellor, with a request that he would bring the subject under the consideration of the Council of the Senate.

On Thursday last in the House of Commons Lord E. Fitzmaurice gave notice that in the event of the Royal Commission reporting on a sufficiently early day before the close of the session, he would call attention to the subject of University reform, and move a resolution.

Count Wilczek, we learn from the *Geographical Magazine*, has announced his readiness to give a reward of 1,000 florins (100*l*.) to anyone who will bring home any news of the Austro-Hungarian Arctic Expedition. The *Tegethoff* steamer, with the members of the Expedition on board, was last heard of on Aug. 21, 1872, on the north-west coast of Novaya Zembya, in about 76° N. lat., when Count Wilczek himself parted company with them and sailed southward in his yacht *Isbjorn*.

A letter from the *Daily News* correspondent with H.M.S. *Challenger* gives some account of the work done by that ship between Simon's Bay and Melbourne. The usual sounding, dredging, and trawling operations were carried on with excellent results; many new specimens have been obtained by the dredge. The ship was at Kerguelen's Island on January 7, and stayed about the island during the month of January, making careful surveys and observations; and collecting specimens both from the sea and land. Previous to the ship's departure from Christmas Harbour, Kerguelen, a cairn was built, and papers of instruction, &c. for the Transit of Venus party left in it. On February 11 the first iceberg was seen when making for Heard Island, and from this time till the beginning of next month, icebergs and drift-ice were met with in large quantities, the ship making one or two narrow escapes; on Feb. 24 the ship was quite close upon the so-called "Termination Island," but no sign of land was seen at all. On March 17 the *Challenger* anchored near Melbourne, all well.

A TRAIN arrived at Algiers from Oran on the 18th inst., six hours behind time, having been delayed by a thick layer of grasshoppers which covered the rails.

THE first meeting of the Board of Governors of the Yorkshire College of Science was held in the Philosophical Hall, Leeds, on April 30. Dr. Heaton was called upon to preside. The business of the meeting was the election of the president, treasurer, council, and auditor for the ensuing year, also the appointment of six endowed grammar schools and ten institutions, each of whose governing bodies should elect a Governor of the College. Lord F. C. Cavendish, M.P. and Mr. W. B. Denison were respectively elected president and treasurer of the College. The following grammar schools were placed in Schedule A:—Leeds, Bradford, Batley, Halifax, Wakefield, and Giggleswick. The institutions placed in Schedule B were the Philosophical Societies at York, Leeds, Bradford, Halifax, Sheffield, and Huddersfield, the Clothworkers' Company of the City of London, the West Riding Coalmasters' Association, the Cutlers' Company, Sheffield, and the Trustees of Ackroyd Charity. Each of these bodies is invited to nominate a member of the Board of Governors.

THE *Times of India* states that Dr. David Wilkie has been appointed by the Government of India to conduct a scientific investigation into the nature, pathology, and causation of the fever prevailing in the Burdwan and Hoogly districts. He is to work in communication with Dr. Lewis and Dr. Cunningham, and under the direction and general superintendence of the Sanitary Commissioner with the Government of Bengal.

UNDER the direction of Mr. Liversidge, Professor of Geology and Lecturer in Practical Chemistry, the Laboratory of the Sydney University is being improved in a way to make it similar to the Laboratory of the Royal School of Mines and the University of Cambridge, and to afford appliances for the proper conduct of the exercises in practical chemistry.

MR. WILLIAM H. DALL resumed his Alaskan explorations under the U. S. Coast Survey, about April 20, at which date he expected to sail for Sitka and more northern points. It is probable that his labours during the present season will be in the neighbourhood of Cook's Inlet and the peninsula of Alaska, and the coast of the mainland as far as the islands of Nunivah and St. Michael's. His duties are to complete a coast pilot of the territory, and to make careful magnetical and other observations. Should his regular work permit, he hopes to make large collections in natural history and ethnology, in continuation of those of previous seasons, and transmitted through the Coast Survey Office to the National Museum at Washington, and which have done him and the Survey so much credit.

HEFT V. of Petermann's *Mittheilungen*, contains Contributions to the climatology and meteorology of the East Polar Sea, by Prof. Mohn; an account of some of the results of Gerhard Rohlf's expedition into the Lybian desert, with a map; and a German translation of the journal kept by Jacob Wainwright, while marching with Livingstone's body from Central Africa to Zanzibar. A copy of this journal was obtained by the late Richard Brenner, the African traveller and Austrian Consul at Zanzibar.

THE additions to the Zoological Society's Gardens during the last week include a Crested Curassow (*Crax alector*) from Guiana, presented by Mr. G. Bruce; a Ring-necked Parakeet (*Palaeornis torquata*) from India, presented by Mrs. A. de Normanville; a Coati (*Nasua nasica*) from South America, presented by Miss E. Waller; a Common Paradoxure (*Paradoxurus typus*) from India, presented by Mr. G. R. Colbeck; two Muscovey Ducks (*Cairina moschata*) from Monte Video, presented by Mr. S. J. Oliff; a Koodoo (*Strepsiceros kudu*) from Africa, deposited.

THE METEOROLOGICAL CONGRESS AT VIENNA *

II.

WITH reference to the organisation of a system of meteorological observations on the Chinese coasts, for advice regarding which the Congress was applied to, a report was adopted setting forth the general principles of organisation suited to the circumstances of China.

In addition to the above, General Myer, as commissioned by the War Department of the United States, proposed that with a view to their exchange at least one uniform observation of such character as to be suitable for the preparation of synoptic charts be taken and recorded daily and simultaneously at as many stations as practicable throughout the world. This proposal the conference adopted, and, as the readers of NATURE are aware, is now in operation.

On these various subjects much valuable information will be found in the discussions in the Reports of the Committees, and in the communications printed in the Appendices, particularly on the subjects of weather telegraphy, sheet lightning, atmospheric electricity, ozone, clouds, atmometers, rain-gauges, and the protection of thermometers.

In the review of the Leipzig Conference (NATURE, vol. viii. p. 342) a hope was expressed with reference to the protection of the thermometers, which is really the vital question of meteorology, that the Vienna Congress would face it, seriously discuss it, and either arrive at some decision, or at least suggest some steps to be taken that might ultimately lead to the uniformity which is so imperatively called for. Unfortunately this has not been done. We say unfortunately, for scarcely two of the head observatories in the British Isles and on the Continent, where continuous or hourly observations are recorded, could be named at which there is uniformity in the protection of the thermometers as respects the box in which they are placed, height above the ground, and position with reference to walls and other surrounding objects. Now till uniformity in the position and exposure of the thermometers be obtained, there can be no comparableness in the results, and consequently the observations are of little value as data for the determination of what must be regarded as the most important fundamental facts on which the science rests, viz. the diurnal and seasonal march of the temperature and humidity of the atmosphere. It is only from the range of the temperature and the humidity of the atmosphere of different regions as ascertained by observations made on a uniform method that we are furnished with physical data for the scientific treatment of such questions as the daily fluctuations of the barometer, and the changes and movements of the atmosphere generally.

Prof. Wild's paper on the exposure of thermometers (p. 77) we recommend to the careful consideration of meteorologists. His observations, instituted at the Pulkowa Observatory at heights of 6¼ ft., 52 ft., and 86 ft., are, as far as we are aware, the best that have yet been made for the purpose of disclosing the influence which mere height, as such, has on the temperature. The thermometers were *placed on a scaffolding constructed of timber lightly put together, and standing in an open field*, being in these essential points in striking contrast with those placed for a similar object on the Chinese pagoda in the Royal Gardens at Kew, it being evident that observations made with thermometers placed like those at Kew will give results which possess little, if any, value in an inquiry touching the vital question of the position and exposure of thermometers.

From the small differences among the mean temperatures he obtained at the different heights, Wild concludes that the height of thermometers above the ground need not necessarily be the same, but may vary between 6 ft. and 33 ft. The differences he obtained as regards mean temperature, though by no means insignificant, are doubtless small; but when we regard the maxima and minima and the observations at particular hours, which in their practical bearings are so important, the influence of height becomes well marked. Hence, if in any meteorological system uniformity as respects height be disregarded, the results so obtained fail to supply the data necessary for a satisfactory comparison of climates. This condition is all the more indispensable when the thermometers are placed at a height of 4 ft. above the ground, at which they should be placed as being the height which gives the best results as regards the application of meteorology to human mortality and other important questions affecting animal and vegetable life.

---

* Continued from p. 18.

We are probably yet a long way from any simple method, suited for general adoption, for observing the *true temperature of the air* at any place by means of the thermometer, so as to eliminate completely the disturbing influence of radiation as regards the thermometer and its protecting screen, or box. This is a problem which may well engage the serious attention of the chief observatories of this and other countries for some years to come. The inquiry may be conducted by ascertaining the true temperature of the air at different hours and seasons by Joule's method, described in a communication to the Philosophical Society of Manchester, November 26, 1867, and comparing the results with those simultaneously obtained by thermometers protected in boxes of different constructions and materials. On this point Wild's paper contains some very valuable observations—valuable, not because they are conclusive, but because they are suggestive, as indicating the line of inquiry which should be pursued. In the meantime all that can be secured is *uniformity*, which would be sooner attained if meteorologists recognised that the following positions of the thermometer are, on physical grounds, inadmissible in researches into the horary fluctuations of the temperature and humidity of the air, viz. the roofs of houses, close or near to walls, over bare soil, in the shadows of trees, walls, or other obstructions, or outside windows. Let it be recognised that observations made under these conditions are of less, and in most cases of no value, then the adoption of 4 ft. as the standard height would follow, and with it the question of uniformity would be almost, if not altogether, settled.

As regards *rain-gauges*, the Congress adopted as the best form for the receiver of the rain-gauge the circular one, with a diameter of 14 in., and at a height of 3 ft., or better 4½ ft., above the ground, a decision which was agreed to by all the delegates except Mr. Buchan, who lodged his protest against it. We have taken the trouble of looking over Mr. Symons' last published *British Rainfall*, and observe that there are not more than half a dozen gauges in the British Isles of this dimension. The readers of NATURE are no doubt aware of the extensive experiments and observations made on this subject in England for some years past, and published annually in the *British Rainfall*, from which it has been experimentally proved that gauges of all sizes from 3 in. to 24 in. inclusive collect amounts not differing more than 2 per cent. from each other. We have had a communication from Mr. Scott, by which we are glad to learn that the Meteorological Office has resolved to retain at its stations the 8 in. gauges hitherto in use. This decision as to the size of the gauge a future Congress will no doubt rescind. Equally in error is the decision as regards height of gauge above the ground, especially large gauges. It is certain from numerous observations made on the subject, that gauges placed at from 3 ft. to 4½ ft. above the ground will not indicate with sufficient correctness the amount of the rain which falls at the place of observation in cases where wind accompanies the rain, owing to the disturbance caused by the obstruction offered by the gauge itself, and by the eddies generated within the funnel. Now owing to the enormous dragging influence of the earth's surface of the wind, these disturbing effects are reduced several fold at the surface and at one foot above it as compared with 3 to 4½ ft. high. On these grounds we cannot recommend British Meteorologists to follow the decision of the Congress. Owing to the extreme variableness of the rainfall, particularly in such countries as Great Britain, where the surface is so uneven, the proper observation of the rainfall requires twenty times more observers than are required to observe any of the other meteorological elements. It is therefore well that a cheap gauge is also a good one, since it facilitates an adequate observation, through numerous observers, of the rainfall, which from its practical and scientific bearings it is so important to know.

In fixing the hours of observation it is essential that those hours be selected which give approximately the mean temperature of the day. The combination of hours which seems to have been most approved both at the Leipzig Conference and the Vienna Congress, and referred to by some very able meteorologists as unconditionally the best, is 6 A.M., 2 P.M. and 10 P.M. The merits of this combination consist in the equal interval of eight hours between the observations, in the close approximation to the daily mean temperature it affords, and in its suitableness for tri-daily charting of the weather. It is, however, a combination of hours which, since it all but absolutely excludes the hours of occurrence of the daily thermometric, barometric, and hygrometric extremes and means, cannot be recommended as generally suitable for meteorological observations of all countries. Indeed, its adoption in tropical and sub-tropical countries would be a blunder. As generally suitable for all latitudes, and for the observation of the principal daily atmospheric phases of temperature, pressure, &c., the best hours are 9 A.M. 3 P.M. 9 P.M., or 10 A.M. 4 P.M. 10 P.M., it being assumed that self-registering thermometers are also used.

We are glad to see that it has been proposed to convene another Meteorological Congress in three years, and hope that some of the questions that form the life-blood of the science will be seriously and adequately discussed by the members of that Congress. The more important of these questions are:—(1) The position and protection of the thermometer for the temperature of the air; (2) A more satisfactory method for observing the humidity of the air, and of making the deductions therefrom; (3) The observation of earth-temperatures, especially at and near the surface, and the depth at which fixed thermometers cease to be suitable; (4) Solar and terrestrial radiation; (5) The examination of the drying qualities of the air by atmometers, so as to secure comparable results; (6) A statement of the conditions which anemometrical stations ought to fulfil, so that the instrument shall indicate the true movement of the air over the region where it is placed, or, if this be unattainable, a means of valuing the observations so as to approximate to it;* (7) Anemometers (Wild's, &c.) for stations of the second order, with which trustworthy observations of wind-force may be made; and anemometers of velocity which admit of their errors being readily ascertained from time to time; (8) an adequate nomenclature of clouds; and (9) the question of atmospheric electricity.

Though the Vienna Congress can properly be regarded as having only concerned itself with questions lying on the outskirts of meteorology, it has done commendable work in thus paving the way for future Congresses, entering on the really important practical questions which united action on the part of meteorologists can alone settle. Until tolerable uniformity be arrived at as regards (1), (2), (5), (6), (7), and (8), in the above paragraph, meteorologists can scarcely be said to have begun to collect data of such a nature as will satisfy our best physicists, and thus lead them to undertake the investigation of the more important of the intricate and difficult problems of the science.

M. COGGIA'S COMET

THE following is an ephemeris to the comet discovered by M. Coggia. It will be seen that the comet will be vastly increased in brilliancy by the month of August.

Berlin Mean time.	R.A.	D.	Brightness (brightness at time of discovery = 1).
	h. m.	° ′	
May 19·5	6 30·9	+ 68 49·4	
28·5	34·34	53·1	
27·5	39·49	59·8	
31·5	45·55	+ 69 8·4	
June 4·5	52·57	19·2	3·8
8·5	7 0·57	31·6	4·5
12·5	10·0	45·1	5·5
16·5	20·17	58·1	6·7
20·5	31·57	+ 70 9·3	8·4
24·5	45·8	16·3	10·6
28·5	59·59	15·2	13·6
July 2·5	8 16·36	0·7	17·8
10·5	56·47	+ 68 15·0	32·3
18·5	9 35·50	+ 62 45·2	64·8
26·5	10 8·57	+ 47 10·9	146·3
Aug. 3·5	21·30	+ 8 52·7	245·0
11·5	10·55	+ 28 17·2	130·8

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 7.—Note on some Winter Thermometric Observations in the Alps, by E. Frankland, F.R.S.

During the past winter the author spent a fortnight at the village of Davos, Canton Granbunden, Switzerland, and had thus an opportunity of experiencing some of the remarkable peculiarities of the climate of the elevated valley (the Prättigan) in which Davos is situated. The village has of late acquired considerable repute as a climatic sanitarium for persons suffering from diseases of the chest.

---

* NATURE, vol. viii. p. 342

The peculiar winter climate of Davos appears to depend upon the following conditions :—

1. *Elevation above the Sea*, which causes greater rarity of the air, and consequently less abstraction of heat from the body, and also secures greater transcalency in the atmosphere by a position above the chief region of aqueous precipitation, and comparatively out of the reach of the dust and fuliginous matters which pollute the lower stratum of the air.

2. *Thick and* (*during the winter months*) *permanent snow*, which reflects the solar heat and prevents the communication of warmth to the air, and consequently the production of atmospheric currents. In still, though cold, air the skin is less chilled than in much less cold air, which impinges with considerable velocity upon the surface of the body. The effect of motion through the air upon the sensation of warmth and cold at Davos is very striking. Sitting perfectly still in the sunshine, the heat in mid-winter is sometimes almost unbearable; on rising and walking about briskly, a delicious feeling of coolness is experienced, but on driving in a sledge the cold soon becomes painful to the unprotected face and hands.

3. *A sheltered position favourable for receiving both the direct and reflected solar rays.*—In this respect Davos-Dorfli, situated opposite to the entrance of the Dischma valley, has the advantage over Davos-Platz two miles lower down the valley, in which latter village the sun rises on December 21 1h. 9m. later, and sets about ten minutes earlier than at Dorfli.

All these conditions contribute not only to a high sun-temperature during the winter months, but also to a comparatively uniform radiant heat from sunrise to sunset.

Addition to the paper, Volcanic Energy: an attempt to develop its true Origin and Cosmical Relations,[*] by Robert Mallet, C.E., F.R.S., &c.

Referring to his original paper (Phil. Trans. 1873), the author remarks that from the want of necessary data he had refrained from making any calculation as to what amount in volume of the solid shell of our earth must be crushed annually, in order to admit of the shell following down after the more rapidly contracting nucleus. This calculation he now makes upon the basis of certain allowable suppositions, where the want of data requires such to be made, and for assumed thicknesses of solid shell of

100
200
400 and
800 miles respectively.

He tabulates his results for these four assumed thicknesses of shell, and shows that the amount of crushed and extruded rock necessary for the supply of heat, for the support of existing volcanic action, is supplied by that extruded from the shell of between 600 and 800 miles thick, and that the volume of material, heated or molten, annually blown out from all existing volcanic cones, as estimated in his former paper, could be supplied by the extruded matter from a shell of between 200 and 400 miles in thickness.

On data, which seem tolerably reliable, the author has further been enabled to calculate, as he believes for the first time, the actual amount of annual contraction of our globe, and to show that if that be assumed constant for the last 5,000 years, it would amount to a little more than a reduction of about 3·5 in. on the earth's mean radius. This quantity, mighty as are the effects it produces as the efficient cause of volcanic action, is thus shown to be so small as to elude all direct astronomical observation, and, when viewed in reference to the increase of density due to refrigeration of the material of the shell, to be incapable of producing, during the last 2,000 years, any sensible effect upon the length of the day. The author draws various other conclusions, showing the support given by the principal results of this entirely independent investigation, to the verisimilitude of the views contained in his previous memoir.

Linnean Society, May 7.—G. Busk, vice-president, in the chair.—Prof. Thiselton Dyer exhibited a fruit of *Telfairia occidentalis* Hook. f., the seeds of which are used parched by the natives of Calabar, and the young leaves and shoots much prized as a green vegetable. The native name is Ubŏng. With reference to the fruit of the *Aristolochia*, hitherto undescribed, Dr. Thomson writes as follows :—"I have seen it, but only so far back as 1859. . . . I cannot trust myself to say more than that the fruit was of a red-brown colour, 5 or 6 in. long, and six-celled, with six well-marked ridges."—Mr. J. R. Jackson exhibited a piece of copal from Zanzibar riddled by ants. After having been some time in the Kew Museum, the living creature was found in the copal and sent to Mr. Walker, who determined it to be a species of *Termes* or white ant, *Eutermes nemoralis* Walk.—The following papers were then read, viz. :—On the discovery of *Phylica arborea*, a tree of Tristan d'Acunha, in Amsterdam Island, in the South-Indian Ocean; with an enumeration of the Phanerogams and vascular Cryptogams of that island and of St. Paul's, by Dr. J. D. Hooker, vice-president. Labillardière stated in 1791 that the islet of Amsterdam (generally confounded with that of St. Paul), lat. 37° 52′ S., long. 77° 35′ E., in the Indian Ocean, was covered with trees, while that of St. Paul, only 50 miles south of it, is destitute of even a shrub. The nature of this arborescent vegetation was unknown until H.M.S. *Pearl* touched at the island in the summer of 1873, when Commodore Goodenough brought off a specimen of what he states to be the only tree growing in the island, together with a fern in an imperfect state. The former proves to be the *Phylica arborea*, of Tristan d'Acunha, and the fern a frond of a *Lomaria*. Amsterdam Island and Tristan d'Acunha are separated by about 5,000 miles of ocean, and are nearly in the same latitude; and Dr. Hooker discusses the various hypotheses which suggest themselves to account for the extraordinary fact of the occurrence of the same species in such widely separated localities. Near the hot springs on St. Paul's Island *Lycopodium cernuum* is found, an interesting example of the occurrence of a tropical species under special conditions beyond its normal range, a phenomenon of which other instances also occur.—Additions to the lichen flora of New Zealand, by Dr. J. Stirton. Communicated by Dr. Hooker, vice-president. The lichens here described were collected by John Buchanan, of the Colonial Museum, Wellington, N.Z., and include a large number of species now described for the first time.—Enumeratio muscorum Cap. Bonæ Spei, by J. Shaw. The general results arrived at in this paper are summed up as follows:—(1) The great majority of the Cape mosses are of northern-hemisphere types, a few being cosmopolites. (2) Some Australian and New Zealand forms are represented; a much larger proportion than is the case with flowering plants. (3) Many forms are strictly localised to particular soils and conditions of climate. (4) The moss flora of the Cape is characterised by an almost total absence of Alpine forms.—Contributions to the botany of the *Challenger* expedition :—No. XV. Notes on Plants collected in the islands of the Tristan d'Acunha group, by H. N. Moseley. Communicated by Dr. Hooker. No. XVI. List of algæ collected by Mr. H. N. Moseley at Tristan d'Acunha, by Dr. G. Dickie. Two new species are described.—On a new Australian Sphæromoid (*Cyclura venosa*); and notes On *Dynamene rubra* and *D. viridis*, by the Rev. T. R. R. Stebbing. Communicated by W. W. Saunders. This form belongs apparently to a new genus. It was found in Sydney Harbour, under stones at the lowest ebb-tides.—Descriptions of five new species of *Gonyleptes*, by A. G. Butler. These are additional to the monograph of the genus already published by the writer.—Observations on the fruit of *Nitophyllum versicolor*, by Mrs. Merrifield. Communicated by the secretary. The paper contains a description of the coccidia of this species hitherto unknown, although the plant was described in 1800.—On *Hieracium silhetense* DC., by C. B. Clarke. The writer disagrees with Mr. Bentham's identification of this species with *Ainsliaea angustifolia* Hook. f. et Thoms.—Notes on Indian Gentianaceæ, by C. B. Clarke.—On some Atlantic Crustacea from the *Challenger* expedition, by R. von Willemoes-Suhm. Communicated by Prof. Wyville Thomson, F.R.S. The paper is divided into seven parts as follows:—(1) On a blind deep-sea Tanaid (2) On *Cystosoma neptuni* (*Thaumops pellucida*); (3) On a *Nebalia* from Bermudas; (4) On some genera of Schizopoda with a free dorsal shield; (5) On the development of a land-crab; (6) On blind deep-sea *Astacus*; (7) On *Willemoesia* (Grote), a deep-sea Decapod allied to *Cryon*.

Anthropological Institute, May 12.—Prof. Busk, F.R.S., president, in the chair.—Messrs. R. and S. Garrard and Co., of the Haymarket, exhibited a very interesting collection of gold objects recently brought from Ashanti. In the discussion Col. Harley, C.B., stated that the Ashantis, and indeed all the tribes of and near the coast, could originate nothing; they were simply copyists, and from frequent repetition of European models, as well as of natural objects, they often attained great skill in the art.—Mr. Francis Galton gave some results of school statistics which he had obtained from Marlborough and Liverpool Colleges. If his applications for co-operation from other head-masters and assistant-masters were equally successful as from these two, he would soon have sufficient material to enable him to establish with certainty the law of growth of the English boys of the present date who are sons of professional men and clergymen and who are educated in the country and reared on the present system of diet and physical and mental work. The result so obtained would serve as a standard of comparison for future periods and for other countries and conditions of life.—A paper, also by Mr. Galton, was read, On the excess of female population in the West Indies.—A paper was read On the probability of the extinction of families, by Rev. H. W. Watson, with prefatory remarks by Mr. Francis Galton. The author remarked that it is not only the families of eminent men, or of the aristocracy, who tend to perish, but also those of municipal notabilities and others. The conclusion that was drawn was that an element of degradation must be inseparably connected with one of amelioration, and that our race is necessarily maintained chiefly through the "proletariat." The problem, which was one purely for the mathematician, was to ascertain what proportion of specified families will necessarily become extinct after a few generations. It would be easy then to measure the diminution of fertility by the frequency of extinction.—Major Godwin-Austen contributed a paper On the rude stone monuments of the Nágás.

---

[*] Read June 20, 1873; Phil. Trans. for 1873, p. 147.

Geologists' Association, May 1.—Prof. Morris, vice-president, in the chair.—On some Carboniferous Polyzoa, by Robert Etheridge, jun. The author showed that, until recently, *Synocladia* was known in this country only from rocks of Permian age, being one of the characteristic corallines of the magnesian limestone. From the Carboniferous series of America, however, a species had been described under the name of *S. biserialis*, agreeing in general habit with the typical *S. virgulacea*, but in some essential characters differing widely. From the Scottish Carboniferous series the author had recently described a species of *Synocladia*, which he termed *Carbonaria*, but which he now believes to be only a well-marked variety of the American Permo-carboniferous *S. biserialis*. The author then proceeded to notice the occurrence of *Polypora* and *Thamniscus* in the Scottish Carboniferous rocks, and concluded by drawing attention to the increasing number of forms, which are gradually becoming recognised as common, in our own country, to the Carboniferous and Permian formations.—On some geological puzzles, by Ed. Charlesworth, F.G.S. Out of many hundreds of teeth of terrestrial mammals, as *Sus*, *Castor*, *Tapirus*, *Felis*, *Hipparion*, *Cervus*, *Bos*, &c., which have been discovered in the red crag of Suffolk and Essex, all, with three or four exceptions, are molars. No bones are found along with the teeth of these land animals. This we can understand, as teeth are so much the hardest parts of the animal frame. There is, however, one curious exception. The *Astragalus* of one or more species of deer is far from uncommon in the red crag. The teeth most abundant in the red crag are those of various kinds of sharks; some of these have a circular perforation, not unlike that made by South Sea islanders in the teeth of sharks at the present day. The occurrence in the red crag of certain stones of a cylindrical form, generally abruptly truncate at one extremity, and having a central cylindrical canal passing through the long axis. Though exhibiting transverse segmental division, if struck with a hammer, they do not separate at the segmental lines. That they did so once may be inferred, from the occurrence of detached segments throughout the crag. The phragmocone of the Belemnite is never found in chalk, or chalk flint, though the guard is extremely abundant. The nature of the cylindrical body, which is occasionally observed to pass in a spiral direction through the body of the Choanite. When a chalk Echinite is filled with flint, but not enveloped more or less in that substance, it is found that the calcite of the shell is partially replaced by silica. This does not occur in those parts of the shell which have flint on the outside.

GLASGOW

Geological Society, April 16.—Mr. E. A. Wuncsh, vice-president, in the chair.—Dr. Robert Brown, F.L.S., read a paper On the Noursoak Peninsula and Disco Island, North Greenland.—Mr. David Robertson, F.G.S., then read a paper On the Recent Ostracoda and Foraminifera of the Firth of Clyde, with some notes on the distribution of the Mollusca. The author said there appeared to be too much readiness to adduce climatal change as a cause of varieties in the fauna, which might only be the consequence of local circumstances. For example, *Terebratula caput-serpentis*, an arctic species, is well-grown and abundant in Loch Fyne, but dwarfed and rare at Cumbrae, in the same depth of water and on similar bottoms, which must be attributable to conditions of habitat and not of climate. With regard to the minuter organisms, Mr. Robertson mentioned a remarkable fact, that they are found in greater abundance in many places exposed to the tossings of the sea than in more sheltered bays and lochs. There can be no doubt that such circumstances as the depth of water, the force of currents, and the condition of the sea-bottom, whether it afforded a suitable habitat for certain species, supplying the food best fitted for their healthy development, as well as furnishing them with a degree of immunity from their enemies, such circumstances, often not easily cognisable, would affect the distribution of animal life in the seas of any given period, and account in a great measure for the absence or sparseness of certain species in one locality and their abundance in another.

PARIS

Academy of Sciences, May 11.—M. Bertrand in the chair.—M. J. A. Serret communicated some remarks on the note by M. l'Abbé Aoust, inserted in the *Compte rendus* of the last meeting.—M. Jamin presented a paper On the internal distribution of magnetism in a bundle composed of several laminæ.—On the carpellary theory according to the (order) Hippocastaneæ, by M. A. Trécul.—General ideas on the mechanical interpretation of the physical and chemical properties of bodies, by M. A. Ledieu.—On the permanence of the intensity of the calorific radiation of the sun, by M. A. Duponchel, a defence of a previous memoir criticised by M. Faye.—Memoir on the determination of the true simple bodies by the actions of electric currents in the voltameter, by M. E. Martin. The author considers the two electricities as imponderable bodies endowed with powerful and opposite chemical affinities, and states views concerning the compound nature of the gases obtained from water by electrolysis, which differ but little in principle from the old theory of phlogiston.—On the mechanical employment of heat, by M. G. West. The author held out hopes of the possibility of utilising the waste heat of engines.—On albuminoid matters, by M. A. Commaille. The author restated the results of his researches on these bodies *àpropos* of M. Béchamp's recent note on the subject. The bodies in question are representable as amides of capronamic acid and of tyrosine, which is the amide of aceto-benzoic acid ($C_{18}H_{11}O_6N$).—M. F. A. Abel presented the continuation of his third memoir on the properties of explosive bodies.—Researches on coniferine. Artificial formation of the aromatic principle of vanilla, by MM. F. Tiemann, and W. Haarmann. The formula assigned to coniferine is $C_{16}H_{22}O_8$ + 2 Aq. The substance is a glucoside decomposing in the following manner:—

$$C_{16}H_{22}O_8 + H_2O = C_6H_{12}O_6 + C_{10}H_{12}O_3.$$

This last product of fermentation ($C_{10}H_{12}O_3$) when oxidised by a mixture of sulphuric acid and potassic dichromate gives aldehyde and a crystalline substance identical with the aromatic principle of vanilla having the formula $C_8H_8O_3$. The reaction was thus represented:—

$$C_{10}H_{12}O_3 + O = C_2H_4O + C_8H_8O_3$$

—On the absolute magnetic declinations observed on the Adriatic coast, by M. Diamilla-Müller.—Observations relating to the memoir by MM. Crocé-Spinelli and Sivel on their (balloon) ascent of March 22, by MM. Lartigue. The facts observed by the aëronauts mentioned, confirm the author's view of the origin of the wind known as the "mistral" which may be generally explained by the great difference of temperature existing between the torrid zone and the temperate and glacial zones.

CONTENTS

PAGE
ON THE ACTION OF THE HORSE. By A. H. GARROD 39
CARPENTER'S "MENTAL PHYSIOLOGY" 40
ANDRE AND RAYET'S "PRACTICAL ASTRONOMY" 42
LETTERS TO THE EDITOR:—
  Quantitative Relations of Cause and Effect.—JAMES COLLIER . . 43
  The Glacial Period.—T. G. BONNEY 44
  Lakes with two Outfalls.—W. B. THELWALL 44
  Glass Cells with Parallel Sides.—FRANK CLOWES 44
  Brilliant Meteor.—WM. W. KIDDLE 44
THE U.S. ACADEMY OF SCIENCE 45
THE LONG PERUVIAN SKULL. By Prof. DANIEL WILSON (*With Illustrations.*) 48
THE COMING TRANSIT OF VENUS, V. (*With Illustrations*). By Prof. GEORGE FORBES 49
OCEAN CURRENTS. By JAMES CROLL 52
BIOLOGY AT CAMBRIDGE. By G. T. BETTANY 53
NOTES 53
THE METEOROLOGICAL CONGRESS AT VIENNA 55
M. COGGIA'S COMET 56
SOCIETIES AND ACADEMIES 56

THURSDAY, MAY 28, 1874

THE AFRICAN ECLIPSE OF 1874

IT is often said that Science is a thing of slow growth, and it must indeed be confessed that if one turns aside from the advancement of Science as a whole to the advance of any one particular branch of it, the statement is too true. Over and over again one gets instances in which crucial experiments suggested by previous work are separated by decades or even by centuries. One cause to which this slow march is undoubtedly to be attributed is the apathy of men of Science themselves. To any science in which they do not themselves excel, and especially to any newly-opened-up branch of their own technic, the attitude of many men, and especially of *official* men, of Science, is not merely one of passive resistance; it is the attitude of the Schoolmen in the time of Galileo over again. We grant that these cramped minds are fortunately in a minority, but the minority is often a powerful one, for the reason, among others, that it is composed of men as a rule advanced in years, far removed therefore from the sympathies, unselfishness, receptivity, and unbounded horizon of youth.

It is a good sign of the times, therefore, when we find a scientific official large-minded enough, and with genius enough, to help on with his whole heart new studies as well as the old; and from this point of view we are especially anxious to draw attention to the fact not only that the total eclipse of April 16 of this year has been admirably observed, but that it has been observed by the Astronomer Royal of the Cape, Mr. Stone, himself, who has thus increased the debt of gratitude which both the mechanical and the physical sides of astronomy owe to him, careless, we doubt not, of the opinion held by a very high authority here in England that the spectroscope—the instrument he employed—is not an astronomical, nay, is not even an optical, instrument!

The line of totality of the eclipse in question struck land near Port Nolloth, on the west coast of Cape Colony, somewhere about 250 miles from Cape Town, and passed over the southern extremity of Africa in a curved line with the convexity turned towards the north, ending at sunset about half way across. There were three points whence the totality might be observed: Port Nolloth on the coast, O'okiep at the opposite extreme inward, a hundred miles away; and Klipfontein, about half way between. The last-mentioned spot was very fortunately the one selected by Mr. Stone. It is known locally as the "Cottage," forming the country or picnicing residence of Mr. Hall, an engineer, and on the brow of a hill rising at least some 2,000 ft. above the level of the sea. On the day of the eclipse down at Port Nolloth there was a cloud through which, as at Port Elizabeth and Graham's Town, the phenomena of the eclipse were all but utterly invisible. Up at Klipfontein the weather and the sky were all that could be desired.

Although full particulars of Mr. Stone's observations have not been received, the *Cape Argus* of April 25, a copy of which has been forwarded to us, contains extracts from private letters received from Mr. Stone, which place us *au courant* with the main points of the observations. The most complete account is as follows:—

"I observed the eclipse from Klipfontein. The day was most favourable, not a cloud being visible. The sight with the naked eye during the few moments I could spare from my work was grand and impressive beyond conception. The eclipse, however, appeared to me to differ a good deal from those lately observed.

"The rose-coloured flames extended very nearly around the moon, although of course of unequal heights at different parts. The corona appeared much less complicated. I saw no outlying brushes, and I should without hesitation express an opinion that all the corona I saw was of the same character throughout and belonged to the sun. The less complication of the corona may, however, have been connected with the purity of the atmosphere and the absence of clouds. I used a four-inch telescope lent me by Mr. H. Solomon. My spectroscope was one of two dense flint glass of 60°. The slit was opened as wide as could allow of a clear sight of Fraunhofer's lines. This was done to insure my being able to see the spectrum of the corona, which was expected to have been very faint. During the partial eclipse I examined most carefully the spectrum near the moon's limb, and away from the limb, to see if any fresh lines could be seen near the moon's limb. None appeared, and consequently there cannot be any medium capable of producing sensible absorption of light around the moon. As the totality drew near, the portion of the sun's disc uncovered was kept half way across the slit. At the instant of the totality the whole field appeared full of bright lines. I believe that all the principal Fraunhofer lines were reversed, and seen as bright lines. One of these lines I am certain was the red line B, but no sooner had I begun to count the lines than the spectrum changed into that of hydrogen gas. This spectrum being well known as that of the rose-coloured flames, I did not care to spend the few moments available upon it; but just glancing at the eclipse to see the brightness of the corona, I turned the telescope upon a bright portion of this beyond the rose-coloured light. The spectrum was much fainter than that of the rose-coloured flames, but there was an ordinary spectrum of some brightness, and across this I feel certain Fraunhofer's lines were still visible, although seen with some difficulty on account of the faintness of the general spectrum. There was also a discontinuous spectrum near the green of one very bright line, and two very faint lines of less refrangibility. I then turned the telescope of the spectroscope over the whole spectrum, from the red to the extreme violet, but I could see no other bright lines than those near the green. My time was now nearly run out, and I turned the telescope again upon the brightest of the lines, and brought the wire of the micrometers to fix its position. The telescope remained untouched until after the totality, when the micrometer was read and the position of the line referred to the Fraunhofer's line near it. This bright line appears to agree in position with the one observed by Young. I am satisfied with the results obtained, considering the instrumental means at my disposal. I have made magnetical observations at three stations, and hope yet to reach the Orange River for the same object. Mr. Carson and Mr. Hall have been kind to an extent that I could never have expected, and have thrown all manner of facilities in our way."

It will be seen that the results obtained by Mr. Stone confirm in an important manner several observations made on the eclipses of 1869, 1870, and 1871. The position of the coronal line 1474 scarcely required confirmation, but the two less refrangible coronal lines observed by Pogson in 1868 have been again seen. The coronal atmosphere was apparently, as might have been expected at this period of minimum sun-spots, smaller than in 1871, while the dryness of the air reduced the atmospheric corona to a minimum. The spectrum of the reversing layer was again seen, thus confirming Young's and Pye's observation of 1870, and the hydrogen lines were seen high up, as in 1870 and 1871. The most important observation, perhaps, made by Mr. Stone is that referring to visibility of the Fraunhofer lines in the spectrum of the coronal atmosphere, showing thereby that that reflects the light of the photosphere.

In a letter to Mr. Solomon, written the day after the eclipse, Mr. Stone states on this point :—"The corona presented a spectrum of a mixed character. I have a strong opinion, amounting almost to certainty, that traces of Fraunhofer's lines were visible, but very difficult to observe. on account of the faintness of the spectrum. The other part of the spectrum of the corona was discontinuous, consisting of three bright lines."

The fact that Mr. Stone has been fortunate both in his weather and in his observations, makes us regret all the more that, the observatory station being so accessible, more efforts were not made in other directions, especially in the direction of photography. A series of photographs taken during the totality, which lasted over 3½ minutes, would have been a precious boon to Science, as the coronal condition of the sun at the periods of maximum and minimum sun-spots could then have been compared. In solar physics, however, we must at present be thankful for small mercies. We willingly agree that a Transit of Venus is a phenomenon to be observed at all cost, but we also affirm that a total eclipse of the sun is, in the present state of knowledge, a phenomenon not second in importance, and we trust that our scientific leaders will not forget that there is a very favourable recurrence of the phenomenon next year.

We are sorry to see that there is a chance of Mr. Stone being left to defray, out of his own pocket, the expenses of an important series of observations, undertaken on his Eclipse journey, on terrestrial magnetism. The *Cape Argus* properly points out that they should be defrayed out of Colonial funds. They are a contribution to Colonial knowledge, and we cannot doubt that the Colonial Government will readily place on the estimates the amount required to meet the cost of transport, which is all that is asked. Mr. Stone gives his own invaluable services and scientific skill without charge; the cost of his journey, so far as the eclipse is concerned, goes to Imperial account; and all that is asked from the Colony is his expenditure on additional journeys, viz. as far as the Orange River, for the magnetic observations referred to. We were very much surprised to hear that any hesitation should have been shown by Government in giving their sanction to the application when first made, and are almost still more surprised to find that it has not been formally acceded to since then. We admire economy, but do not admire parsimony; and we are perfectly certain that no sort of vote would be passed more heartily and unanimously by Parliament than that for the paltry amount of some sixty or seventy pounds sterling required to defray the expenses of these magnetic observations.

The same number of the *Cape Argus* gives us some information also as to the effect of the eclipse upon the natives. A digger at the diamond-fields told his natives that if they did not find a big stone that day they would see something in the firmament that would frighten them. Just as the darkness was commencing a Kafir brought a 45-carat diamond that had been found a few hours previously. In Natal the Zulus stopped work when the eclipse began, and resumed when it was over, demanding two days' wages, the eclipse, in their opinion, having been a short night. The general effect on the natives at the diamond-fields is thus described in a local paper :—"The natives rushed out of their claims horror-stricken, and said that the sun was dying. The grandest living tableau ever seen was the great gathering of horror-stricken nudes on the Colesberg Kopje, watching, with fearfully rounded and glaring eyes, mouth open and fingers pointed at what they believed to be the dying moments of the Almighty luminary whose majesty is the only God they know. The effect of the eclipse on the imagination of the natives, as depicted in their countenances, is described as terrible. They grouped together upon the heights of the Kopje and on the top of Mount Ararat, silent and awe-stricken. The natives knew nothing of the meaning of the ghastly light that preceded the darkness; gloom came upon their labours silently as a thief in the night, and it was not until the whole of the mines presented a sulphureous appearance that they left their work. When they did leave it they left it with a rush, crying one to the other, 'The sun is dying.'"

FOOD AND DIETETICS

A Treatise on Food and Dietetics. By F. W. Pavy, M.D., F.R.S. (J. and A. Churchill.)

THE want of a scientific work on Food and Dietetics has been much felt for some time. Experiments in various directions, both physiological and pathological, have been long accumulating, and have much needed arrangement and satisfactory condensation. Dr. Pavy has supplied the deficiency, and in the work before us gives an excellent account of all the most important observations which have any bearing on the subjects he discusses, tempered by the results of his own extended and judicious experience.

Our knowledge of foods in the chemical, zoological, and botanical point of view, that is as far as composition and derivation are concerned, is considerably in advance of our acquaintance with the true physiological bearing of the facts; and in this section of the subject Dr. Pavy does not attempt to do more than give the well-known analyses and descriptions of previous workers. His object, in the portion of the book devoted to the alimentary principles and the principles of dietetics, is to show how the tendency of modern experiment is to modify and almost subvert the ingenious theories of Liebig as to the functions of the different constituents of our customary diets.

After some introductory remarks on the dynamical relations of food, in which a simple explanation is given of the results obtained by Grove, Mayer, and Joule, as far as they affect the physiology of alimentary principles, the constituent elements of food are discussed both theoretically and practically. Physiologically the separation of the ingesta into "food" and "drink" is shown to be unsuitable. "The two material factors of life are food and air; and food may be considered as comprising that which contributes to the growth and nutrition of the body, and, by oxidation, to force-production." The great question of the relation of nitrogenised and non-nitrogenised matter to external body-work performed is entered into in considerable detail, and the important experiments of Fick and Wislicinus, Parkes, and Austin Flint, are described in full; to them being added others, performed by Mr. Mahomed in the author's laboratory, on the length of time required for the elimination of the products of metamorphosis of an increased amount of nitrogenised food, from which it may be inferred that urea is produced and eliminated within the three hours following the ingestion of the nitrogenised matter.

It is shown that the original theory of Liebig, in which it is assumed that muscular action involves the destruction of muscular tissue, which till lately has been so generally accepted, "although, in reality, constituting a speculative proposition, unsupported by anything of the nature of proof," is opposed to all the results of recent investigation, and that if it were true "we should have to look upon nitrogenous alimentary matter as forming, through the medium of muscular tissue, the source, and the only source, of muscular power. The renewal of muscular tissue for subsequent oxidation in its turn, and evolution of muscular force, would thus constitute one of the functions of nitrogenous alimentary matter; and on its supply would accordingly depend our capacity for the performance of muscular work." Great stress is laid on the necessity for the combination of nitrogenised with non-nitrogenised food for the sustenance of the body in a vigorous condition; and Mr. Savory's experiments on this point are shown to be quite insufficient to prove the inference which has been frequently drawn from them, namely, that nitrogenous matter, combined only with the appropriate saline principles, suffices for the maintenance of life.

The author reduces the unnecessarily extensive literature on the action of alcohol, which is so very negative in character, into a very moderate space, remarking that "from a review of the evidence as it at present stands, it may reasonably be inferred that there is sufficient before us to justify the conclusion that the main portion of the alcohol ingested becomes destroyed within the system; and if this be the case, it may be fairly assumed that the destruction is attended with oxidation and a corresponding liberation of force, unless, indeed, it should undergo metamorphosis into a principle to be temporarily retained, but nevertheless ultimately applied to force-production. The subject appears to me to be open to physiological as well as chemical investigation, and probably some additional light may be hereafter thrown upon it by an approach through the former channel."

The discussion of the sources of each of the different most important articles of diet is followed by a concise account of its practical value. In the present time of excessive tea-drinking, the following description of the action of tea is of particular interest. "To express in a few words the advantages derivable from the use of tea, it may be said that it forms an agreeable, refreshing, and wholesome beverage, and thereby constitutes a useful medium for the introduction of a portion of the fluid we require into the system. It secures that the water consumed is safe for drinking by the boiling which is necessitated as a preliminary operation in making tea. It cools the body when hot, probably by promoting the action of the skin; and warms it when cold, by virtue, it would seem, of the warm liquid consumed. In a negative way it may prove beneficial to health by taking the place of a less wholesome liquid. Through the milk and sugar usually consumed with it in England, it affords the means of applying a certain amount, and not by any means an insignificant amount, viewed in its entirety, of alimentary matter to the system. Experience shows that it often affords comfort and relief to persons suffering from nervous headache. It also tends to allay the excitement from, and counteract the state induced by, the use of alcoholic stimulants; and further, on account of its anti-soporific properties, like coffee, it is useful as an antidote in poisoning by opium."

Besides the important purely physiological problems that are entered into in the work before us, there are so many which have a strictly practical bearing, and they are treated in so clear and impressive a manner, that the ordinary reader cannot but feel that he has derived great benefit from a careful study of its contents. Much stress is laid in the chapter on Practical Dietetics on the importance of a midday meal:—"A fairly substantial meal should be taken at this time, and it does not signify whether it goes under the name of luncheon or dinner." Carnivorous animals apparently thrive best when fed at long intervals; herbivorous, when they are constantly eating. Man being omnivorous, his food should be taken at intervals of much less duration than the carnivora, and therefore in diminished quantities at each, three fairly substantial meals during the day, at intervals of five or six hours being found the best in the long run. "There are many business or professional men who, after leaving home for their office or chambers in the morning, do not taste food, or, if they do, take only a minute quantity, until they return in the evening. Actively engaged all day, their system becomes exhausted, and they arrive home in a thoroughly jaded or worn-out condition. They expect that their dinner is to revive them. It may do so for a while, but it is only a question of time how long this system can be carried on before evil consequences arise." It is therefore stated as a *sine quâ non* that the interval between breakfast and late dinner should be broken by a repast about half-way between them.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Physical Axioms

MR. COLLIER's letter demands from me a reply, which I will endeavour to make as brief as possible.

Mr. Spencer, instead of answering the difficulties which I had shown his *à priori* view of the Second Law of Motion to involve, only noticed my remarks to dismiss them summarily with the lofty sentence that I "proposed to exemplify unconsciously-formed preconceptions," and had committed an absurd blunder in so doing. And now, because it did not appear to me worth while, at the expense of your space and your readers' patience, explicitly to repudiate any such lofty purpose, and so, adopting Mr. Spencer's words, I merely called attention to the fact that the example (of whatever it might be considered to be an exemplification) was of Mr. Spencer's own choosing, I am charged by Mr. Spencer's follower, Mr. Collier, with having "confused issues," which I neither raised nor accepted. If Mr. Collier will do me the favour of reading my original note again, he will find that the object of my remarks was simply to test the truth of a definite assertion by Mr. Spencer that "the Second Law of Motion is an immediate corollary of the preconception of the exact quantitative relation between cause and effect." It was entirely beside my purpose to discuss the general psychological question of the formation of conceptions or preconceptions farther than as it is involved in the truth or otherwise of this particular assertion. Mr. Collier's note is therefore, as far as regards my remarks, entirely irrelevant and needs no other reply than to invite him, as Mr. Spencer declines to do so, to answer the simple and definite questions proposed by me as difficulties which Mr. Spencer is bound to answer, unless he is prepared to admit that he was wrong in the assertion on which I commented.

I have assumed throughout that Mr. Spencer means to assert that the Second Law of Motion is *involved in*, not merely that it *involves*, a particular preconception. And yet this latter is all that Mr. Collier asserts in the summing up of Mr Spencer's argument, with which he concludes his note. If Mr. Collier truly represents Mr. Spencer, I can only say that, while the assertion may be admitted to be true, it certainly appears to me to be so trite as to be hardly worth formulating. The whole question turns on the distinction between "involving" and "being involved in," which I suppose Mr. Spencer and Mr. Collier would regard as an important one, though it is difficult in some cases to make out distinctly from their language and their line of argument which they mean to imply.

Passing in conclusion beyond the particular issue to which I have hitherto confined myself, I would remark that to my mind all that Mr. Spencer's and Mr. Collier's illustrations prove is that, while unconscious experiences (whether individual or inherited) may give rise to certain general, but (except in the very simplest cases) vague, preconceptions, it is only when these preconceptions are wedded to consciously-made observation or experiment that they cease to be barren generalities and give birth to the fruitful laws of Physical Science. To a mathematician, at any rate, it is almost ridiculous to observe how little either Mr. Spencer or Mr. Collier seem to realise the great gap between the indefinite observation that two things always increase and decrease simultaneously, and the definite conclusion that they are proportional to one another. For example, it is hardly a parody of Mr. Collier's remarks to say:—"A child discovers that the greater the angle between his legs the greater the distance between his feet, an experience which implicates the notion of proportionality between the angle of a triangle and its opposite side;" a preconception, as it appears to me, with just as good a basis as that whose formation Mr. Collier illustrates, but one which, as I need hardly add, is soon corrected by a conscious study of geometry or by actual measurement.

Harrow, May 25 ROBT. B. HAYWARD

MR. COLLIER'S letter, NATURE, vol. x. p. 43, is even more astonishing than anything that Mr. Spencer has written. A mathematician who reads it feels something like Alice behind the looking-glass; and perhaps behind the looking-glass it may be "a question pertaining to the psychological basis of inductive logic," with which mathematicians, as such, have nothing to do. But in this world, this side the looking-glass, in which forces are measured and effects are measured, Mr. Collier's letter is very perplexing.

For example, after giving several instances in which a greater force produces a greater effect, Mr. Collier proceeds: "The experiences these propositions record all implicate the same consciousness—the notion of proportionality between force applied and result produced · and it is out of this latent consciousness that the axiom of the perfect quantitative equivalence of the relations between cause and effect is evolved."

Does Mr. Collier know what proportionality means? Does any one of the experiments indicated prove that where effort is doubled the result is *doubled?* The child pulls his boat by a string through the water; if he pulls twice as hard does he pull it *twice* as fast?

It seems to me that the people on the other side of the looking-glass think perfect quantitative equivalence (however measured) means the same as proportionality; and are willing to raise first the general result of experience, that greater forces produce greater effects, into an axiom of exact quantitative equivalence (without troubling themselves to consider how quantity is to be estimated), and then to accept Newton's Second Law as an instance of this quantitative equivalence, without showing any connection between quantitative equivalence and direct proportionality in that instance or in any other.

A SENIOR WRANGLER

Ocean Circulation

MR. CROLL will doubtless be of opinion that as my "theories" show such an utter ignorance of "even the elements of physics and mechanics," I can employ my time much better in acquiring some knowledge of those sciences, than in continuing to discuss the subject with him.

I shall be glad to be allowed to state to the readers of NATURE, as I have to those of the *Philosophical Magazine* (May), other grounds on which I must decline to prolong this discussion.

1. Mr. Croll has charged me (Phil. Mag. for March, p. 177, note) with a serious misstatement in regard to the mean annual rate of the Gulf Stream, which he affirms to be *nearly double* what I have represented it. Now *my* statement was avowedly based on the *average of the whole year's observed rates;* whilst Mr. Croll has taken as the basis of *his* the arithmetical *mean* between the maximum and the minimum. It has been said in disparagement of statistics that "anything can be proved by figures;" and Mr. Croll, who is nothing if not a statistician, seems to me to justify the imputation, for the adoption of his method would make the *average* number of children of a marriage to be at least *ten!*

2. Mr. Croll, in asserting that I have left out of consideration "the fact that the sea is salter in intertropical than in polar regions, and that this circumstance, so far as it goes, must tend to neutralise the difference of temperature," has only exhibited his own ignorance of a very important fact of Ocean Physics—the *low* salinity of equatorial surface-water; which was ascertained in Kotzebue's voyage fifty years ago, has been confirmed by many later series of observations, has been repeatedly cited in text-books, and has been adduced by myself as an indication that polar water is continually ascending from the bottom to the surface under the equator. But further, not only has this fact been confirmed by the *Challenger* observations, but so remarkable an accordance has been shown by them to exist between the low specific gravity of equatorial *surface*-water and that of equatorial *bottom*-water, as strongly to indicate that, as the latter is certainly polar, the former is so also. It suited Mr. Croll's purpose, however, with these observations before him, completely to ignore them, and to state as fact what is the precise contrary of facts.

3. According to Mr. Croll and his anonymous authority, the Astronomer Royal must be unfamiliar with even "the elements of physics and mechanics;" for, speaking from the chair of the Royal Society in 1872, he explicitly expressed his acceptance of the doctrine I advocate, as "certain in theory and supported by observation." The eminent meteorologist, Prof. Mohn, of Christiania, also, who expressed to me in writing last year his acceptance of it, must be equally ill-informed; as, too, must be Dr. Meyer of Kiel, who has been engaged for four or five years past in the investigation of the physics of the Baltic, the North Sea, and their connecting channels, and who has satisfied himself so completely of the power of small differences of specific gravity to put large bodies of water in motion. I have *nowhere said* that no eminent physicist shares Mr. Croll's objections; though I have not myself met with such a one.

I regret to have been forced, by the personal attacks in which Mr. Croll has latterly thought fit to indulge, thus to retort upon him. Henceforth I shall not consider myself called upon to take any notice of assertions and arguments which I do not find to exert the least influence on the opinions of the eminent scientific men with whom it is my privilege to associate.

WILLIAM B. CARPENTER

Glacial Period

IN answering Mr. Bonney's letter in NATURE, vol. x. p. 44, I shall confine myself to the consideration of his second objection to my theory, as the precise southern limit of the glacial action is not of present importance, and the height of the Scandinavian sea-beaches is irrelevant to the inquiry.

Mr. Tiddemann, in an admirable paper On the glaciation of North Lancashire (Quart. Journ. Geol. Soc., vol. xxviii. p. 471), has mapped out the course of the ice as shown by scratched rocks, lines of transported boulders, carriage southwards of local drift, and direction of overturned edges of shaly strata, and proved that it did not flow down the valleys to the westward, but passed across them and the ranges separating them, from the north to the south. On the other side of the Irish Sea the Rev. Mr. Close and others have shown that there also the ice did not move down the valleys, but flowed along the coast southwards. The ice-scratches still preserved on the rocks prove that the configuration of the land was nearly the same then as now, and no explanation has ever been offered of this southerly movement of the ice, excepting that it was prevented from flowing down the natural slope of the land by the whole of the Irish Sea having been at the time filled with ice up to a height of about 2,000 ft. above the present sea-level. The Isle of Man, that lay in the path of this great ice-stream, is glaciated from top to bottom, and it must have been completely buried in ice. It is to the action of this great agent that I ascribe the pushing up of sand and shells over south Lancashire, Cheshire, and North Wales on one side, and Wexford and around Dublin on the other, of the Irish Sea, where the course of the ice southward was obstructed by the narrowing of the channel.

So far from the movement of this great mass of ice being deflected or warded off by local glaciers, we have seen that in north Lancashire it was not affected by them; and long ago Prof. Ramsay proved that the glaciation of Anglesea and the west of Caernarvonshire had not radiated from the high land, but that the ice had come from the north and brought with it numerous boulders from the mountains of Cumberland.

As to the possibility of ice, pushed forward by higher accumulations behind it, thrusting before it loose sand and shells up to higher levels, I may remark that there are many proofs that it possesses this power. In the Isle of Man blocks of granite have been pushed up 600 feet above the level of their source. Mr. Tiddemann has also shown that as the ice moved across the valleys down one side and up the other, it thrust over the edges of the strata. On the other side of the great English watershed, Mr. Dakyns has shown that the ice when ascending the slope of a valley opposed to its course swept before it all the drift lying on the surface, pushing it over to the other side of the range.

Mr. Bonney would be more likely to damage my theory if, instead of protesting against it, he could explain some of the many difficulties that beset that of submergence. Where was the shore of that mythical sea under which England nearly to the Thames is supposed to have been submerged? How is it that not a single undisturbed bed of glacial shells has been found, that nearly all are broken to pieces, that many fragments of Cyprina exhibit glacial scratchings, and that not a single instance has been recorded of the two valves of a lamellibranch having been found together? Was there no friendly cliff or cavern able to preserve a single shell from the ruthless second advance of the ice? Mr. James Geikie finds the fragile bones of water-rats and frogs in his "inter-glacial beds," and uninjured land and fresh-water shells occur in abundance; but not one marine shell has been found in the uplands that does not show proof of having been transported, by being broken, worn, or scratched.

Since my first letter was sent to NATURE, Prof. Ramsay has drawn my attention to Mr. Croll's theory, that the glacial shells of Holderness had been pushed up by ice over the land out of the German Ocean. From other papers of the same geologist, I gather that he does not dispute the submergence of much of England and Scotland during part of the glacial period, and has indeed proposed a theory to account for it. So far as I know I stand alone at present in the opinion that neither during nor since the glacial epoch has there been any submergence of a great part of the British Isles beneath the waters of the ocean, nor can I expect that a theory so contrary to what has been taught for many years by English geologists will obtain a ready acceptance.

THOMAS BELT

Ealing, May 22

Uncompensated Chronometers

WITH reference to the employment of an uncompensated chronometer to indicate the mean temperature of an accompanying compensated chronometer during a long journey, with a view to the application of the proper correction for temperature, Prof. G. Forbes remarks (NATURE, vol. x. p. 50):—

"This method is quite new, and has not been tested by any nations except the Russians."

Permit me to direct attention to the following passage in the "Report on the Coast Survey," which I extract from p. 66 of the Proceedings of the American Association for the Advancement of Science, Springfield meeting, August 1859. The "Cambridge" referred to is Cambridge, Massachusetts.

"The difference of longitude between Cambridge and Liverpool has also been determined by means of large numbers of chronometers carried repeatedly between the two stations on the Cunard steamships. These chronometric expeditions, in the words of Mr. W. C. Bond, director of the Harvard Observatory, 'for the magnitude and completeness of their equipments, have not been equalled by any of the similar undertakings of European Governments. Even the *Expedition chronometrique* of Struve was on a scale much less extensive.' The voyages were continued through a number of successive years. The first great special expedition took place in 1849, and the most recent in 1855. In the latter the effect of temperature on the rate of the chronometers formed a subject of special investigation. For each instrument the effect of temperature on its rate was ascertained by experiment, and the average temperature during each trip was kept account of by means of a thermometric chronometer, constructed like the others, but with individual balance, so that its daily rate was affected by six seconds for a change in temperature of 1° Fahr. Fifty-two chronometers were employed in this expedition, and were transported six times between Cambridge and Liverpool."

The "Greenwich Observations" for many years past (fifteen at least) contain a record of the indications of a "chronometrical thermometer" accompanying the chronometers on trial for purchase by the Admiralty; and on p. 2 of "Rates of Chronometers" in the volume of Observations for 1871 are these words:—

"The chronometrical thermometer differs from an ordinary chronometer only in the construction of the balance, the positions of the metals forming the compensating rims being reversed. By this arrangement the effect of temperature is much magnified."

J. D. EVERETT

Malone Road, Belfast, May 22

Photographic Irradiation

IN NATURE, vol. x. p. 29, the article on the coming Transit of Venus makes mention of photographic irradiation as having "been found by Lord Lindsay and Mr. A. C. Ranyard to be mainly due to the reflection of light from the back of the glass plate. It can be almost entirely avoided," Mr. Forbes goes on to say, "by wetting the back of the plate and placing black paper against it." This subject has been investigated, explained, and the above remedy suggested years ago by practical photographers. In 1867 I used the plates of the Liverpool Dry Plate Company, then sent out with the backs painted red to prevent irradiation.

But even this is not a complete preventive. Colouring the film, as suggested by Mr. Carey Lea of Philadelphia and Henry Cooper, a well-known English amateur, is a much more effectual means, though at a loss of sensitiveness; but the most complete (where the dry emulsion process is available) is to allow the collodion to be acted on by a large excess of nitrate of silver for a considerable time and then to convert this into bromide of silver by addition of ammonium bromide. The result is that the film has a dull opaque character like unglazed porcelain, and not only stops the light more completely than an ordinary collodion film, but remedies another cause of irradiation—the molecular reflection in the film itself.

Two years ago I tested plates prepared in this way on the most difficult subjects (not astronomical) and found the halation much less than by any other means except a deep red tint in the film.

W. J. STILLMAN

Hay Fever

REFERRING to the recent article in (NATURE, vol. x. p. 26) upon hay fever, I can give my own experience as having suffered from the complaint for some years past, mainly in the months of May and June. My most severe attacks have been in the house in early morning. I am, however, near hay-fields, and a tramp, by way of experiment, through one of these has more than once satisfied me of the efficacy of the hay pollen in vastly increasing the troublesome symptoms.

The treatment I have used to myself has consisted of rather strong doses of quinine taken internally, and externally a piece of linen rag dipped in strong camphorated spirit and placed upon the nose and also partly over the nostrils.

Inhaling the vapour of a piece of camphor inclosed in a small silver tube, and carried in the mouth like a cigar, has also, I know, been used with effect. I have judged that the attacks are, to a certain extent, connected with a depressed or relaxed state of the system, partly from the time (early morning) when I have found them at their worst, and partly from the fact that in a pure bracing air like Switzerland I do not get them, even in the haying season. A French lady with whom I once travelled by train tried to satisfy me I had only influenza (*la grippe*), but our passage through a hay-field soon brought on such a succession of sneezings, &c., that I was quickly accorded the honour of a distinct disease.

I tried the homoeopathic remedy of extract of hay grasses in spirit, upon the advice of a friend, but I very soon came back again to my allopathic doses of quinine and camphorated spirit, and from these alone have I found any real benefit. I have not yet tried the solution of quinine applied to the nostrils.

Guildford, May 18 J. RAND CAPRON

THE STEAMSHIP "FARADAY" AND HER APPLIANCES FOR CABLE-LAYING*

THE lecturer in his introductory remarks observed that an electric telegraph consisted essentially of three parts, viz., the electro-motor or battery, the conductor, and the receiving instrument. He demonstrated experimentally that the conductor need not necessarily be metallic, but that water or rarefied air might be used as such within moderate limits; at the same time, for long submarine lines, insulated conductors strengthened by an outer sheathing were necessary to insure perfect transmission and immunity from accident. The first attempts at insulation, which consisted in the use of pitch and resinous matters, failed completely, and in the years 1846 and 1847 the two gums india-rubber and gutta-percha were introduced, the former by Prof. Jacobi of St. Petersburg, and the latter by Dr. Werner Siemens of Berlin; this last gum soon became almost indispensable to the cable-manufacturer on account of its great plasticity and ductility.

The first outer sheathing used was a tube of lead drawn tightly over the insulated wire, and this again was covered with pieces of wrought-iron tubing connected by ball and socket joints; in this way the Messrs. Siemens successfully crossed various rivers. This method was superseded later on by the spiral-wire sheathing, first proposed by Mr. Bret in 1851 for the Dover and Calais cable; since then, with few modifications and exceptions, this form has been universally adopted.

The lecturer next enumerated the casualties to which submarine cables are liable, and the precautions employed to obviate them. He showed specimens destroyed by rust and the ravages of a species of Teredo. On the Indo-European line a curious case of fracture occurred; a whale, becoming entangled in a portion of cable overhanging a ledge of rock, broke it, and in striving to get free had so wound one end round its flukes that escape became hopeless, and so had fallen an easy prey to sharks, which had half devoured it when the grappling iron brought his remains to the surface. Other enemies to be dreaded are landslips, ships' anchors, and abrading currents.

The new Atlantic cable consists, for the deep-sea portion, of copper conductors, gutta-percha insulators, and a sheathing of steel wires covered with hemp; the shallow-water part consists of similar conductors and insulators sheathed with hemp, which in turn is covered with iron wire.

In paying out, the great point to be observed is that no catenary should be formed, but that the cable should be a straight line from the ship to the sea-bottom; the retaining force should be equal to the weight of a piece of cable hanging vertically downwards to the bottom of the sea. In picking up, a catenary is formed, but a vertical position is the best.

From the peculiar nature of the service for which a telegraph-ship is required, it is evident that she must possess properties somewhat different from those of ordinary ocean-going steamers; thus speed is not so important as great manœuvring powers, which will enable her to turn easily in a small space, or by which she may be maintained in a given position for a considerable time. In the ship about to be described an attempt has been made to meet these requirements.

The *Faraday*, of 5,000 tons register, was built at Newcastle by the eminent firm of Messrs. Mitchell & Co.; she is 360 ft. long, 52 ft. beam, and 36 ft. depth of hold; there are three large water-tight cable tanks having a capacity of 110,000 cubic ft., these are each 27 ft. deep, two are 45 ft. in diameter, and one is 37 ft., they can take in 1,700 miles of cable 1½ in. in diameter. After the cable is coiled in, the tanks are filled up with water to keep it cool, for the lecturer had found, when conducting experiments on the Malta and Alexandria cable with his electrical resistance thermometer, that heat was spontaneously generated in the cable itself, whereby its insulation was seriously endangered.

The *Faraday* has stem and stern alike, and is fitted with a rudder at each end; both are worked by steam-steering apparatus placed amidships, and are capable of being rigidly fixed when required. She is propelled by a pair of cast steel screws 12 ft. in diameter, driven by a pair of compound engines constructed with a view to great economy of fuel. The two screws converge somewhat, and the effect of this arrangement is to enable the vessel to turn in her own length when the engines are worked in opposite directions. On the voyage from Newcastle to London a cask was thrown overboard, and from this as a centre the ship turned in her own length in 8 minutes 20 seconds, touching the cask three times during the operation. This manœuvring power is of great importance in such a case as repairing a fault in the cable, as it enables the engineer to keep her head in position, and, in short, to place her just where necessary in defiance of side-winds or currents.

The testing-room of the electrician in charge is amidships, and so placed as to command the two larger tanks, while the ship's speed can be at all times noted on the index of a Berthou hydrostatic log.

The deck is fitted with machinery to be used in laying operations, which will be best described by tracing the path of the cable from the tanks to the sea. Let us begin with the bow compartment: the cable, which lies coiled round one of Newall's cones, begins to be unwound, passes up through an eye carried on a beam placed across the hatch, next over a large pulley fitted with guides, and by a second pulley is gently made to follow a straight wooden trough fitted with friction rollers, which carries it aft to near the funnels; here it passes through the "jockey," which is a device for regulating the strain, consisting of a wheel riding on the cable, which can be adjusted by a lever, and a drum fitted with a brake, thence it passes on to a "compound paying-out and picking-up machine;" this consists of a large drum provided with a friction brake, and round it the cable passes three times; it is also furnished with a steam-engine, which by means of a clutch can be geared on to the drum when required. Now in paying out, the cable causes the drum to revolve as it runs over it, and the brakes regulate the speed as the vessel moves onward; but should a fault or other accident render it necessary to recover a portion, the drum is stopped and geared on to the engine, the ship's engines are reversed, the stern-rudder fixed; and so what was formerly the bow is now the stern, while the little engine hauls in the cable over the same drum which before was used to pay it out; thus it is coiled back into the same tank whence it started. By this means the necessity of passing the cable astern before proceeding to haul it in is avoided. It was during this operation that an accident befell the Atlantic cable in 1865, causing its loss for the time.

---

* Abstract of a lecture delivered at the Royal Institution on May 15.—By C. William Siemens, D.C.L., F.R.S.

The next apparatus is a dynamometer, consisting of three pulleys, one fixed, and the centre one, which rests on the cable, movable in a vertical plane; by this the strain is registered and adjusted. After passing this the cable runs into the sea over a pulley carried on girders and constructed so as to swing freely on an axis parallel to the length of the ship, so that, should the vessel make lee-way, the pulley will follow the direction of the cable, and thus friction and sharp bends are avoided. The bows are also fitted with a similar pulley, compound machine, and dynamometer. We see that by these devices the cable is kept perfectly under control, and should a fault be discovered a simple process of reversal of ship and machinery brings home the faulty portion.

Another great point is to keep the vessel trimmed and steady. For the former requirement nine separate water-tight compartments, including the cone in each tank, which also is hollow, are provided, so that water may be admitted as the tanks are emptied of cable, and thus the ship is kept trimmed. To ensure steadiness and avoid the rolling to which telegraph ships are subject, two bilge keels are set on at an angle of 45°; this was done at the suggestion of Mr. Wm. Froude, whom, said the lecturer, "I have to thank for valuable advice and assistance on several new points connected with the *Faraday*."

A steam-launch is carried on deck, whence she can be lowered into the water with steam up, ready to land shore ends and perform other useful details.

Another class of work for which the vessel is fitted is "grappling" for lost or faulty cable. In shallow seas this is a very simple operation, but in deep water it is rather a delicate matter, and requires the co-operation of two or even three vessels, so as to lift the cable without forming an acute angle, and thus to lessen the chance of fracture or strain. A special rope made of steel wire and hemp, and of great strength, is provided for this kind of work. Some specimens shown could bear strains up to 16 tons.

In conclusion, the lecturer paid a high compliment to the late Prof. Faraday, noticing the great services he had rendered to electrical science, his singleness of purpose, and the invariable kindness with which he had encouraged younger labourers in the same field. The friendly encouragement which he himself had experienced from him would ever remain a most pleasing remembrance. He had seized with delight on the present opportunity to pay a tribute to the honoured name of Faraday, and was happy to be able to do this with the full consent of the revered lady who had stood by the philosopher's side for forty years, while labouring under this very roof for the advancement of knowledge. The name of the vessel and her mission in the service of Science would combine, he thought, to create an interest in her favour in the minds of the members of the Royal Institution, and he hoped that on the morrow she would put to sea accompanied by the earnest wish, "God speed the *Faraday*."

ATMOSPHERIC CURRENTS AS OBSERVED IN THE WEST INDIES, AND PARTICULARLY IN ST. THOMAS

DURING an average period of nine months in the year the regularity of the air-currents over the Virgin group resembles clockwork. The surface, or lowest current, is formed by the trade-wind, which blows briskly from the north-north-east, with a slight variation northward during the night and early morning, and a corresponding deflection southward from noon till near sunset. Varying in strength from a light breeze to a brisk gale, it is hardly ever absent; its greatest strength is usually at or near 3-4 A.M., and about the same hours P.M. It generally bears with it light masses of cumulus, from which there fall occasionally showers, heavy, but very short in duration. This air-current, known as the trade-wind of these regions, does not appear to exceed 2,000 feet in vertical height.

Next above this current comes the south-west wind, rarely absent; it brings with it light cirrus clouds, but seldom cumulus or other indications of rain; its excess of moisture having been probably discharged while crossing the mountains of the South American continent. Very rarely, indeed, does this wind descend low enough to have effect on or even near the surface; when it does so, which generally occurs during the summer and autumn months, it is deflected to the south, and then becomes loaded with moisture, and accompanied by heavy nimbus clouds and electric phenomena.

Highest of all the west wind reigns, manifested by very light cirrus clouds, rapidly formed and as rapidly disappearing; it has at times a slight deflection to the north.

These three winds blow with scarcely any interruption from November to June inclusive; almost the only variation being then afforded by the north or north-north-east wind which sometimes prevails, but near the surface only, for a few days together during three winter months. When—a rare but much-desired event—a southerly current occurs about this time, it brings heavy clouds and abundant rain. While the wind is from the north and north-east, great dryness is indicated by the hygrometer.

But in the months of August, September, and October, and often in the latter half of July, the polar or north-east current loses its strength, and is often neutralised or even conquered by the southerly winds. These during the summer are usually light, and accompanied by a clear and serene sky, only clouded when the north-east, regaining for a time its supremacy, drives the south back, and precipitates heavy showers, amid thunder and lightning, sometimes lasting for three or even four hours; after which the wind veers round again to the south-east and south. The same phenomena, when intensified, concentrate themselves into a hurricane or cyclone—a rare occurrence in this island, not more than four of any great severity having taken place at St. Thomas in the course of the present century. Two indeed, but only of medium violence, occurred within these regions last year, neither of them however visited St. Thomas, the one keeping out to sea eastward, and not touching the coast till it reached lat. 44° in its northerly course; the other, which seems to have originated within the Caribbean Sea, did considerable damage on the coasts of St. Domingo and Cuba, passing ultimately north-east by the Florida Channel. Of both I have given details elsewhere (vol. ix. p. 468). Heavy gales, occasionally amounting to storms, sometimes blow here, particularly during the winter months, from between north and north-east, but from no other quarter of the compass. They are accompanied by cold, the thermometer sinking to 74° F., or even lower, with a dull, cloudy sky, and little rain.

Another phenomenon, peculiar to the winter and spring months, are white squalls; they take place on calm days, generally at noon, and most often at no great distance from shore; their area is very limited, and their duration does not exceed a few minutes; in some respects they resemble a miniature hurricane, and appear to be due to similar causes; but neither have I witnessed in them nor heard recorded any instance of circular motion. They are much dreaded by the small craft of these seas; a slight fall of the barometer is their only premonitory indication.

St. Thomas W. G. PALGRAVE

THE COMING TRANSIT OF VENUS[*]

VI.

HAVING now discussed all the methods to be employed, and the chief difficulties to be encountered, it is time to examine what has actually been done. What method or methods ought to be chosen? What stations are most suitable, taking into account the chances of good or bad weather and good or bad anchorage? What preparations have been made by the various Governments and by private individuals? And are the arrangements satisfactory?

As to the choice of method, the observation of contacts was the only kind originally contemplated. The employment of photography and heliometers is a comparatively new idea, and will be spoken of later. The observation of contacts is applicable to three methods, for each one of which different stations must be chosen; these are Halley's method, the method of durations, and De l'Isle's method. We will consider these in order.

1. Halley's method fails totally in the transit of 1874, but *may* perhaps be applied in 1882, though not under good conditions. On referring to Fig. 13 in Article III., it will be noticed that Sabrina Land is a station where in 1882 the transit will commence just before sunset, and end just before sunrise. Hence during the transit this station and another placed in America will be moving in opposite directions, thus fulfilling the conditions required by Halley in his communications to the Royal Society. By referring to Fig. 12 it will be seen that no such stations exist in 1874.

2. The method of durations may be successfully applied, so far as mere geometrical position is concerned, in either of the two transits. This method is really combined of two parts, and includes Halley's as a particular case. The lessening of the duration of the transit depends partly upon the diminished motion of one of the stations, or upon the fact that it moves in the opposite direction to the other; and partly on the fact that in one case the planet seems to trace a path on the sun farther from his centre (and therefore shorter) than in the other. The difference in this last case is greatest when the path of Venus is far from the sun's centre. But in transits like the coming ones, where this is the case, the motion of Venus towards the sun's centre at the time of contact is very much slower than when she describes a large chord upon the sun. This has been well pointed out by Mr. Stone,[†] and from his paper we learn that the method of durations depending upon two such observations at each of the two stations will not be so satisfactory as we might otherwise have expected. But other very serious objections present themselves to a method like this requiring four observations of contact, when we carefully consider the circumstances. In applying this method, one station must be chosen in high southern latitudes. Now diligent inquiries have been made upon this subject, and it appears very improbable that the weather at any suitable station will be such as to give much hope of observing both the ingress and egress in a satisfactory manner. Hence if we depended upon this method there would be a great probability of the expedition proving a failure. The method of De l'Isle requires the observation of only one contact at each of the two stations. For these reasons hardly any expedition will use this method except as secondary to De l'Isle's, the photographic, or the heliometric method.

3. De l'Isle's method. The accuracy with which this method can be applied depends upon the certainty of longitude operations. From what was said in the last article, it will be seen that this is no easy matter; but it is absolutely necessary that it must be done if this method is to be employed. Sir George Airy says that longitudes can be determined with an error of not more than one second by lunar observations; and observers will receive orders to remain at their stations until they have a sufficient number of observations to accomplish this. The lunar observations will be supported, where practicable, by telegraphic determinations of longitude, and also by the transport of chronometers. The Russians, whose stations lie mainly along the whole length of Siberia, will employ a telegraphic line over that region, with branch lines to the subsidiary stations. The English will probably fix the longitude of Alexandria by submarine cable. They will employ chronometers to group together all stations neighbouring each other. The station at Rodriguez will be thus connected with Lord Lindsay's station at Mauritius, and with the French station at Réunion. Lieut. Corbet, R.N., will connect by chronometers the various islands occupied by the Germans, Americans, and French in the neighbourhood of the two English stations on Kerguelen's Island. The three English stations on the Sandwich Islands will likewise be connected by chronometers; and it would be very desirable to connect these islands with San Francisco on the one hand, and Yokohama on the other. The longitudes of both these places will have been compared with Greenwich by telegraph. It would be a matter of the utmost interest to complete the chain round the world by the transport of chronometers across the Pacific. M. Struve says that with the aid of an uncompensated chronometer this might be done with great accuracy. The Germans have also made valuable suggestions for comparing the longitudes of the observing stations of all nations; and the French will also probably help in this matter. Thus it is likely that the longitudes of all the stations of different countries suitable for the application of De l'Isle's method will be very accurately known.

It will be noticed that the accuracy of De l'Isle's method depends upon two longitudes and two observations of contact; while that of durations depends upon four observations of contact. Neglecting all considerations of climate the two methods are, so nearly as the somewhat vague data at our command can tell us, very nearly equal. But the uncertain climate of southern seas renders the chance of many contact observations doubtful and throws the balance in favour of De l'Isle's method. Add to this that before long all the stations except the Kerguelen group will soon have their longitudes determined absolutely by telegraph, and recollecting that the coming observations are to serve astronomers until the next transit of Venus in 2004, by which time even the Kerguelen group may perhaps be chronometrically determined: recollecting all this, there is little doubt that astronomers have been wise in settling upon De l'Isle's method for the main observations of contacts.

It will be well, before going further, to mention the stations which have been chosen by different nations for the observation of the coming transit.

I.—The British, having selected for the reasons above mentioned the method of De l'Isle, originally fixed upon the following stations:—

Alexandria, Sandwich Islands, Rodriguez, Kerguelen's Island, and New Zealand. No alteration has been made in the choice of these stations. Supplementary ones have, however, been added. Thus at Kerguelen's Island there will be two expeditions: one at Christmas Harbour in the north, and the other in the south of the island. In the Sandwich Islands there will be three stations: one at Honolulu, a second on the island of Hawaii, and a third on the island of Kauai, sometimes called by English writers Atooi. The station at Alexandria will be supplemented by a second one at Cairo, and a private one by Col. Campbell, of Blythswood, under the Astronomer Royal's direction at Thebes. The New Zealand station will be placed at Christchurch. Since the idea of photography has been introduced, two additional stations have been added by the Indian Government under the superintendence of Col. Tennant, R.E. These are very completely equipped, and will probably be situated the one near Peshawur, the other at Roorkee.

---

[*] Continued from p. 52.

[†] Monthly Notices of the R.A.S., vol. xxix. p. 250.

Besides these the observatories at Madras, Cape of Good Hope, Melbourne, and Sydney will be utilised so far as possible. The New South Wales Government have voted 1,000*l.* for other observations in Australia. The English Government have voted 15,000*l.* for all the expeditions, but a much larger sum than this will be actually required. It will be understood that the principal method of observation is De l'Isle's, aided everywhere when possible by all the other methods except the heliometric.

From the account that has been given of the difficulty of determining the longitudes of the different stations it will be seen that no little power of organisation is required for the execution of the foregoing programme. All preparations must be made for the observation of the moon culminators. Alt-azimuths must be made, and also actually invented for the express purpose. Nearly fifty chronometers must be provided, and negotiations must be completed with telegraph companies. The photographic operations have required the invention of a new photoheliograph, and the Janssen method of a new application to it. The observations of contact have required the purchase of a large number of equatoreals; for each station, besides having a 6-inch telescope, has also one or more smaller instruments. One of the larger ones, made by Simms, is shown in Fig. 18. The transit instruments have also been made expressly for this expedition. Besides this all the accessories of these instruments had to be provided. Huts for receiving them had to be made. Forms for entering and reducing the observations had to be prepared and printed. For some of the stations sleeping arrangements, cooking apparatus, washing utensils, and provisions had to be provided. Workmen, masons, and assistant photographers, besides twenty-two observers, had to be collected and trained to the work. When this is considered it will be seen that no ordinary man could fulfil all the duties. Fortunately we have in our Astronomer Royal a man who combines to an exceptional degree theoretical, mechanical, and organising powers; and we may safely say that the present expedition has been completed under a generalship quite unparalleled in the annals of Science. Sir George Airy has accomplished all that was required in a manner that has called forth the applause of those who have been connected with the preparations for this perhaps the most important astronomical event of the century. We must congratulate ourselves upon the fact that he has been most liberally supported on all points by the British Admiralty. If we cannot enter into the same details with regard to other nations, it is only because we have not had the opportunity of learning all their actions. But we cannot conclude this account of the British Government expedition without alluding to the valuable services which have been rendered to it by Capt. G. L. Tupman, R.M.A., who has spent the last three years in training himself and nearly all the other observers in the use of the instruments, seeing the instructions of the Astronomer Royal carried out, ordering the stores, and in the most disinterested manner looking after the expedition; so that (as the Astronomer Royal has lately pointed out) if the observations be successful their success will in a great measure be due to his exertions.

II. Besides the expeditions under the direction of the British Government, another has been prepared which is perhaps the most completely equipped one which has ever been undertaken by a private individual in the interests of astronomy. Lord Lindsay has made preparations to take up his position at Mauritius, provided with means for utilising all the different modes of observation. He will combine his own results mainly with those of the Russians; and it is probable that no station could have been found more suitable for a single observer to occupy when so many different methods are employed. All the instruments are of the most perfect description and made by the best makers. The photographic method which he will employ has been already described. The siderostat has been made expressly for this purpose, and its surface has been tested and found to be truly plane. Lord Lindsay and his assistant Mr. Gill lay considerable stress on the employment of the heliometer, and have discussed its capabilities with great lucidity. They propose to make observations of the external contact by the aid of the spectroscopic method. The expedition will be provided with about 50 chronometers, including one uncompensated. These will be transmitted four times between Aden and Mauritius. It is probable that they will also connect the longitudes of the different stations on that group of islands by chronometers. The German expedition at Mauritius will probably be connected with Lord Lindsay's by a trigonometrical survey. Of these islands two can be connected by direct signals with a heliotrope reflecting the sun's light. From experiments made in Russia, it appears that a signal may thus be seen in a mountainous country with a clear atmosphere at a distance of 200 miles. There is little doubt then that the longitude of each station on this group of islands will be accurately known.

III.—The Germans are sending out five or six expeditions. At Cheefoo the accelerated ingress and retarded egress will be observed; at the Macdonald Islands the retarded ingress and the accelerated egress. The Auckland Islands will be favourable for accelerated egress; Mauritius for retarded ingress, and Ispahan for retarded egress.

They will probably employ all the four methods at most stations, viz. eye-observations of contact, heliometers, photo-heliographs for the distance of centres, and also for position-angles. There will be no photography at Mauritius. Here will be employed four heliometers by Fraunhofer, 3 in. aperture, 3½ ft. focus; four equatorially-mounted telescopes by Fraunhofer 4½ in. aperture, 6 ft. focus; two photo-heliographs by Steinheil, 5½ in. aperture, and two with quadruple object-glasses of 4 in. aperture. Besides these, instruments are required for determining the local time and the longitude; for the Germans lay great stress on De l'Isle's method. For this purpose transit instruments with diagonal telescopes on the Russian method of 2⅜ in. aperture will be supplied, and alt-azimuths with divided circles 12 in. to 14 in. diameter. The necessity of determining the longitudes accurately has led the German astronomers to consider carfully the best means by which this can be done. Dr. Auwers, to whom the direction of the arrangements has been entrusted, has discussed the matter in a very able manner. It appears from his inquiries that each group of stations will have their longitudes very accurately determined. Thus the stations in east Asia can be connected telegraphically. So also can those about Alexandria; also those about the Caspian Sea and New Zealand. The group of islands near Kerguelen's, the Sandwich Islands group, and the Mauritius group will be determined by chronometers. The only difficulty is to connect these different groups. Many of them will be compared with Greenwich indirectly by telegraph. It is probable that Honolulu will be compared by chronometers with San Francisco and Yokohama, thus completing, as already mentioned, the telegraph and chronometer connection round the world. In any case there is little doubt that before the transit of Venus in 2004 the longitude of Honolulu will be determined by telegraph. Since Lord Lindsay intends to compare the longitude of Mauritius with that of Aden by four chronometer expeditions, aided by an uncompensated chronometer, there is little doubt that the longitude of that group of islands will be accurately known. The group of islands about Kerguelen's will depend very much upon the British observations of the moon; but it will be well if chronometers could be employed to connect it with the Cape. The Germans rely very much upon the heliometric method. It will be a matter of great interest to learn how these observations agree with other methods as a guide to the arrangements for 1882. The expense of this expedition is about 130,000 thalers, besides the expenses connected with chronometric determinations.

The organisation of the German expedition has been entrusted almost wholly to Dr. Auwers, as secretary of the commission. His contributions to the subject are of great value, and the zeal with which he has superintended the expeditions, even in the minutest details, cannot be overvalued.

IV. The Russians are mainly employed in utilising the Siberian stations. The actual places which have been chosen from which to observe the transit are given in the following list, in order from east to west. The numeral 1 appended to a station means that there are good observers, practised with the model, good equatoreals, and a heliometer or photo-heliograph. The numeral 2 signifies the same without heliometers or photo-heliographs. When the numeral 3 is appended, the observer has not practised with the model, and employs a small telescope. The stations are:—

Yeddo 2
Port St. Alga 3
Nakhodka 2
Wladivostock 1
Port Possiet 1
Lake Hanka 1
Chabarovka 2
Peking 2
Blagowvschtchenska 2
Nertschinsk 1
Xhita 1
Kiachta 1
Tomsk 3
Tachkent 1
Port Peroffski 1
Fort Uralsk 1
Orenburg 3
Aschura-deh 1
Teheran 2
Nachitzevan 2
Erivan 1
Tiflis 3
Taganrok 3
Kertch 2
Ialta 2
Thebes 2

Besides these stations the following will be utilised, but the sun will be very low: at Kazan the sun's altitude will be 8° or 10°, at Nicolaif it will be 6°, and at Charkof and Odessa 5°; at Moscow it will be exactly on the horizon.

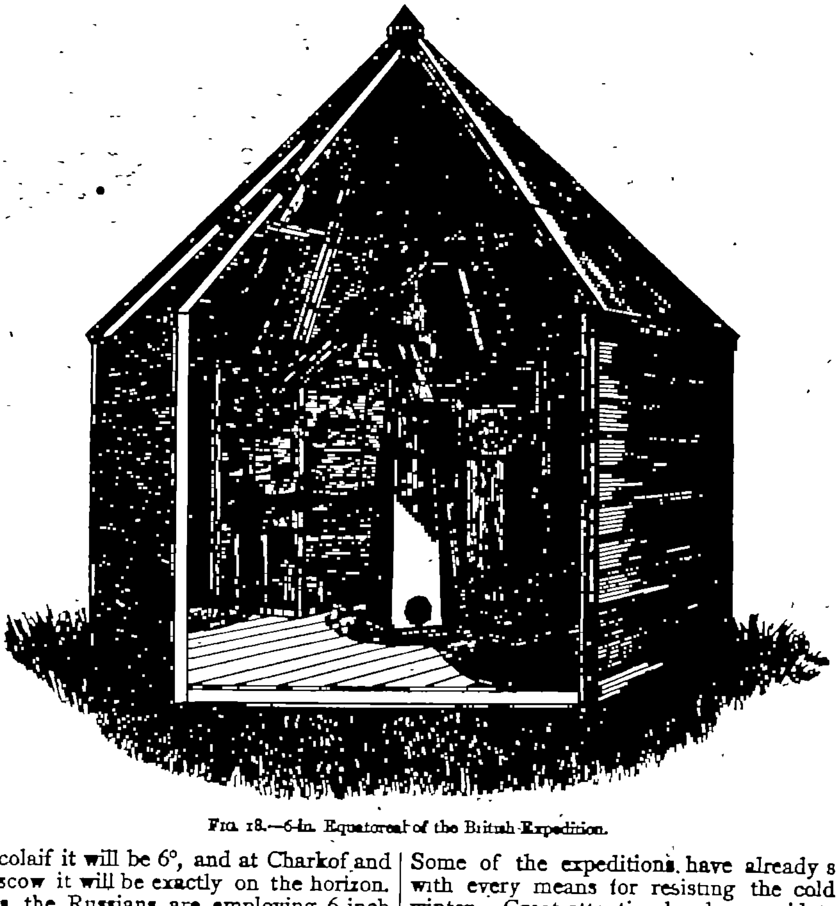


FIG. 18.—6-in. Equatoreal of the British Expedition.

As to instruments, the Russians are employing 6-inch and 4-inch equatoreals. Their heliometers are larger than those of the Germans, having 4 in. apertures. Their photo-heliographs are constructed on the English model by Mr. Dallmeyer. The telegraphic connections between the stations have been already discussed. The expense incurred will be defrayed by the Government. Besides this, the State contributes 45,000 roubles. This will be spent mainly on the transport and maintenance of observers and instruments. The different observatories in Russia have shared the expense of providing the different instruments. The whole expedition has been conducted under the superintendence of M. Otto Struve. Some of the expeditions have already started provided with every means for resisting the cold of a Siberian winter. Great attention has been paid to the chances of good weather. The accelerated ingress and retarded egress will thus be admirably observed; and the comparison which M. Struve has made with observers of other countries in practising with the model will render comparisons possible. Moreover, many of the Russian stations are admirably situated for the employment of the method of durations; and if the two internal contacts be observed at any of the stations in the neighbourhood of Kerguelen's Island excellent results may be obtained.

GEORGE FORBES

(*To be continued.*)

ATOMS AND MOLECULES SPECTROSCOPICALLY CONSIDERED *

LET me commence by congratulating you on the circumstance that this School and the Literary Society connected with it are known over a much more extensive area than Whitechapel. It is some time ago since I first heard of the work which you are attempting to do, and which indeed to a large extent you are doing, in this part of London. All friends of Science must deeply sympathise with your efforts, and I looked upon it as my bounden duty to come here and lecture when asked to do so. I have one more remark to offer: as I knew that my audience would consist if not altogether of old students of Science in this school, still of those largely interested in mental culture and in the acquisition of useful knowledge, I thought it right to ask you to follow me into a region which a few men in lands far apart are now investigating—a region which lies outside the known, and which is being explored by means of the spectroscope. I hope to be able to suggest a few thoughts to some of you, in case you have worked with that instrument, and I hope also to be able to place before those who have not, many facts with which they are already acquainted, in a new point of view.

Now, in the first place, what are Atoms and what are Molecules? A chemist will tell you about the atomic weight of certain elements, and you will hear him talk about molecular volumes, and the like. Here is a definition given by Dr. Frankland in his book on Chemistry ("Lecture Notes," p. 2): "An atom is the smallest proportion by weight in which the element (that is to say the element to which the atom under discussion belongs) enters into or is expelled from a chemical compound." He then points out that when atoms are isolated—that is, when they are separated from other kinds of matter—they do not necessarily exist as atoms in the old sense; they go about in company, generally being associated in pairs. He then defines such a combination of atoms as an elementary molecule. Here, then, is put before us authoritatively a chemist's view of the difference between an atom and a molecule.

Let us now go to the physicist and see if we can gather from him his idea of atoms or molecules. It is remarkable that, in a most admirable book, Prof. Clerk-Maxwell's "Theory of Heat," in which you find nearly all that is known by physicists about molecular theories, the word "atom" is not used at all. We are at once introduced to the word "molecule," which is defined to be "a small mass of matter the parts of which do not part company during the excursions which the molecule makes when the body to which it belongs is hot."

Prof. Clerk-Maxwell goes on to give us ideas about these "molecules," which have resulted from the investigations of himself and others; and if you will allow me, I will read a few extracts from his book (p. 286): "All bodies consist of a number of small parts called molecules. Every molecule consists of a definite quantity of matter, which is exactly the same for all the molecules of the same substance. The mode in which the molecule is bound together is the same for all molecules of the same substance. A molecule may consist of several distinct portions of matter held together by chemical bonds, and may be set in vibration, rotation, or any other kind of relative motion, but so long as the different portions do not part company but travel together in the excursions made by the molecule, our theory calls the whole connected mass a single molecule." Here, then, we have our definition of a molecule enlarged. The next point insisted upon by our author is that *the molecules of all bodies are in a state of continual agitation.*

That this agitation or motion exists in the smallest parts of bodies is partly made clear by the fact that we cannot see the bodies themselves move.

Now in a solid body the molecule never gets beyond a certain distance from its initial position. The path it describes is often within a very small region of space. Prof. Clifford, in a lecture upon atoms, has illustrated this very clearly. He supposes a body in the middle of the room held by elastic bands to the ceiling and the floor, and in the same manner to each side of the room. Now pull the body from its place; it will vibrate, but always about a mean position; it will not travel bodily out of its place. It will always go back again.

We next come to fluids: concerning these we read—"In fluids, on the other hand, there is no such restriction to the excursions of a molecule. It is true that the molecule generally can travel but a very small distance before its path is disturbed by an encounter with some other molecule; but after this encounter there is nothing which determines the molecule rather to return towards the place from whence it came than to push its way into new regions. Hence in fluids the path of a molecule is not confined within a limited region, as in the case of solids, but may penetrate to any part of the space occupied by the fluid."

Now we have the motion of the molecule in the solid and the fluid. How about the movement in a gas? "A gaseous body is supposed to consist of a large number of molecules moving very rapidly." For instance, in this room the molecules of the air are travelling about twenty miles in a minute. "During the greater part of their course these molecules are not acted upon by any sensible force, and therefore move in straight lines with uniform velocity. When two molecules come within a certain distance of each other, a mutual action takes place between them which may be compared to the collision of two billiard balls. Each molecule has its course changed and starts in a new path."

The collision between two molecules is defined as an "Encounter;" the course of a molecule between encounters a "Free path." It is then pointed out that "in ordinary gases the free motion of a molecule takes up much more time than is occupied by an encounter. As the density of the gas increases the free path diminishes, and in liquids no part of the course of a molecule can be spoken of as its free path."

Now the kinetic theory of gases, on which theory these statements are made, has this great advantage about it, that it explains certain facts which had been got at experimentally, facts which had been established over and over again, but which lacked explanation altogether, till this molecular theory, which takes for granted the existence of certain small things which are moving rapidly in gases, less rapidly in fluids, and still less in solids, was launched. The theory in fact explains in a most ample manner, many phenomena so well known, that are termed "laws." It explains Boyle's law, and others, well known to students of this school. This theory, which takes for its basis the existence of molecules and their motions, explains pressure by likening it to the bombardment of the sides of the containing vessel by the molecules in motion; or it tells us that the temperature of a gas depends upon the velocity of the agitation of the molecules, and that this velocity of the molecules in the same gas is the same for the same temperature, whatever be the density. When the density varies, the pressure varies in the same proportion. This is Boyle's law. Further, the densities of two gases at the same temperature and pressure are proportional to the masses of their individual molecules, or, when two gases are at the same pressure and temperature, the number of molecules in unit of volume is the same. This is the law of Gay Lussac.

I have now fairly introduced you to the atom of the chemist and the molecule of the physicist, you will see at once that the methods of study employed by chemical and physical investigators are widely different. The chemist never thinks about encounters, and the physicist is careless as to atomic weight; in his mind's eye he sees a perpetual clashing and rushing of particles of matter, and he deals rather with the quality of the various motions than of the material.

Next let me say a little more about these "encounters," and here I must again refer you to Prof. Clerk-Maxwell's book (p 306) It is assumed that while the molecule is traversing its free path after an encounter, it vibrates according to its own law, the law being determined by the construction of the molecule, or let us say its chemical nature, so that the vibration of one particle of sodium would be like that of another particle of sodium, but unlike that of a particle of another chemical substance, let us say iron. If the interval between encounters is long, the molecule may have used up its vibrations before the second encounter, and may not vibrate at all for a certain time previous to it. The amplitude of the vibration will depend upon the kind of encounter, and will be independent of the number of encounters.

We can imagine a small number of feeble encounters, a large number of feeble encounters, a small number of strong encounters, and a large number of strong encounters.

In the case of feeble encounters, we pass from a small number to a large one by increasing the density.

In the case of strong encounters we pass from low temperature with small density to high temperature with great density.

Increase of density will reduce "free path."

---

* Revised from short-hand notes of a Lecture delivered to the Whitechapel Foundation School Literary and Scientific Society, March 10, 1874.

Increase of temperature will increase amplitude.

The shorter the free path the more complex the vibrations.

The greater the amplitude the more will the vibration of the molecule be brought out, not merely the *fundamental vibrations*, as we may term them, which we get in the free path, when it is longest, but the *overtones*.

Now why have I risked wearying you with these detailed statements concerning the vibrations of "molecules?" Because we believe that each molecular vibration disturbs the Ether; that spectra are thus begotten; each wave-length of light being set in vibration by a molecular vibration of corresponding wave-length. The vibration is, in fact, the sender; the spectrum is the receiving instrument, in this new telegraphy.

Now there are two questions which I propose to discuss, and they are these:—What light does the spectroscope throw upon molecular questions? and is there any hope that the spectroscope, as researches with it are extended, may aid the study of a subject which lies at the root of chemical and physical investigation?

I have written down several statements, which I propose to discuss one by one. I shall state the experimental basis, when it exists, on which the statements rest and the methods by which the results have been obtained

I shall for a time use the word "particle" to represent a small mass of matter, because it does not tie me to the "atom," or the "molecule" of the chemist, or to the "molecule" of the physicist. "Particle" is a neutral term, which I hope none of you will quarrel with.

1. My first proposition is this:—*When particles are aggregated together, so as to form a solid or liquid, they give out rays of light of certain refrangibilities; and the spectrum is continuous as far as it goes.* This was Kirchoff's first generalisation.

It surely is an important fact from the point of view of the molecular theory that all solids and liquids, with their particles moving as already stated, do give you a perfectly distinct spectrum from that which you get when you deal with any rare gas or vapour whatever. A poker put into the fire becomes of a dull red heat, after a time a white heat is arrived at. As far as the vibrations exist they are continuous, there are no breaks in the series of wave-lengths. You may also get a platinum wire, and drive it to incandescence in the same way by means of electricity. Analyse the light by means of the spectroscope, the spectrum is the same as that of the poker Further, we can go to the sun, and divest it in imagination of the atmosphere which absorbs much of its light, and we know that, with a small exception, we shall get a perfectly continuous spectrum similar to that in the case of the poker or platinum wire. Connected with spectroscopic investigation there is this wonderful fact, that as it deals with matter in the most general way, it is perfectly easy to carry on a line of argument, not by referring to different chemical elements, but to matter, now on the earth, now in the sun, or again in some of the stars. It is a great leveller. In this continuous spectrum we have a spectroscopic fact connected with that kind of molecular motion which physicists attribute to particles so long as they are closely packed together in the solid state, and so long as they have but a small free path as in the fluid state.

2. I now come to my second proposition:—*When particles are in a state of gas or vapour, and are rendered incandescent by high tension electricity, line-spectra are produced in the case of all the chemical elements.*

I have several photographs which I will throw on the screen, showing such spectra as these now in question. We have thus the spectra of the light given off by the vapour of cobalt and of nickel rendered incandescent by means of high-tension electricity. I will next show you the spectra of other chemical elements, such as aluminium and iron compared with nickel and cobalt, pure and impure iron compared with a meteorite. These line-spectra are only to be obtained from gases and vapours, and as a rule only when we employ high-tension electricity.

We get a perfectly distinct spectroscopic result from the one we had before, precisely in the case where according to the physicists we have an enormous motion and agitation of molecules.

3. I now proceed to the next proposition:—*In some cases particles in a state of gas or vapour can be set swinging by heat waves.* I have here some salts of sodium and strontium, these I place in the heat of a Bunsen burner, they are at once dissociated and the particles of the metals are set swinging by the heat waves and we get their longest lines. Now that is not only true for strontium and sodium, but for many other elements. But if I put salts of iron, or of the other heavy metals in the flame, I shall not get bright lines. Or again, in some other vapours, such as sulphur, we only get a spectrum, not of lines, but continuous over a limited part of the spectrum. In fact I may say that with the exception of those elements which easily reverse themselves, this heat is absolutely incompetent to give me anything like a bright line.

4. *Particles, the amplitudes of vibrations of which may either be so slight that no visible light proceeds from them, or so great that they give out light of their own, absorb light of the same wave-length and of greater amplitude passing through them*

Consider how beautiful this statement is when you look at it in the light of its teaching with regard to particles. We throw sodium into a flame and get a yellow light; we place it on the poles of our electric lamp and render it incandescent, and its light is rich yellow.

We have similarly incandescent sodium outside the sun, through which the rays of sunlight pass outwards towards the earth, and we may have similar non-luminous sodium vapour in a test-tube; and the vibration which gives the yellow light, in the case of the sun, and which is invisible in the vapour of the tube, instead of giving a bright line gives a dark one. Let me show you some photographs of the solar spectrum, so that as you have seen the bright lines due to radiation, you may see the dark lines in the solar spectrum which are due to absorption.

Our knowledge of the elements existing in the sun and stars depends entirely upon the principle first suggested by Stokes, that particles are set swinging when light waves pass through them with the particular rate of vibration which they effect.

The elements to which a large number of the Fraunhofer lines are due have been determined by means of the vibrations of particles on the earth. Whether a particle vibrates on the earth or on the sun it does not matter to the spectroscope, the vibration is the same, but as the particle is set vibrating at the sun by a greater amplitude of the light passing through it we get a dark line instead of a bright one. To show that in the stars, representing to us other suns, the spectra are very various I will exhibit spectra of the three classes of stars into which most may be grouped In the middle we have a simple line spectrum, in the centre a more complex one, and at the bottom a channelled spectrum.

5. Next I have to point out to you that *line spectra become more complicated as the particles are brought nearer together, provided the state of gas or vapour be retained.* See the importance of this observed fact in connection with the molecular theory. If in the solid the particles can only oscillate round their mean position, if in the gas they can go through with enormous rapidity a tremendous number of various movements of rotation and vibration, and along their free path; and if spectroscopically we can follow these movements by differences in the phenomenon observed, is it too much to hope that in the coming time we shall have an enormous help in our inquiries? We get a solid or liquid condition, and a continuous spectrum; we get the most tenuous gaseous condition and then the phenomenon is changed, and the spectrum consists of a single line. So far indeed as the visible spectrum goes, it is possible by working with the gas at low pressure, and not too high temperature, to get a spectrum from any gas or vapour of only a single line, and as you increase the density, and thus force the particles closer together, and make the conditions of the gas approximate in the way of aggregation more to those of a solid, so does the spectrum get more and more like that of a solid, till we see at last a bright continuous spectrum. Take, for instance, hydrogen, and use, not an ordinary air-pump, but a Sprengel mercury pump; use this for three or four hours, and observe the spectrum of the gas. It is a single line. Fill the tube again with gas, at ordinary atmospheric pressure, double the pressure, or multiply it ten or more times, and what becomes of the line? Not only does that green line which first appeared get more and more obvious and thick, but more lines appear, and they get thicker, till at last there is such a background of continuous spectrum that these are all invisible as lines. At twenty atmospheres the spectrum is as continuous as that of a solid.

6. Here is my sixth proposition:—In the case of metals *there are two different ways in which the continuous spectrum is approached.* Mind I do not say reached, for there may be much more to learn on this point. To render this clear I must show you some more photographs and explain the method by which they have been obtained. Here I have a coil and a jar, and here the poles. We drive the metal of which these poles are composed into vapour, the vapour is rendered incandescent; the spectrum we should get would therefore be one of bright lines. Now,

instead of bringing the spectroscope close to the poles, in which case, in every part of the spectrum, we should get light from every part of the spark, I prefer to use a lens, by means of which I throw an image of the spark on the slit; then in each strip of the total visible spectrum is the spectrum of some particular part of the vapour. Think the matter over a little for yourselves. These poles are perpetually giving off vapour, which is constantly going away; some of it is being oxidised, some of it is travelling away along the currents of air set up. What follows? There must be more vapour close to the pole than in the interval between the poles; that will be still more true if I make the interval between the two poles longer. In the part between the two poles, if they consist of two different elements, we have three distinct spectra. In the upper part, a region rich in the upper vapour; in the lower, one rich in the lower vapour; between them one which is rich in neither We have then at least three distinct layers, so to speak, in the spectrum, the spectrum of the vapour of the upper pole the spectrum of the vapour of the lower one, and also of the central region. The number of particles of each vapour will decrease from each pole. You will see in a moment that much the same condition of affairs will be brought about, if, instead of using a spark, I use an electric arc, in which the pure vapour of the substance which is being rendered incandescent fills the whole interval between the poles, the number of particles being smaller at the *sides* of the arc. Now I can throw an image of such a *horizontal* arc on a vertical slit; the slit will give then the spectrum of a section of the arc at right angles to its length. You have a photograph of such a spectrum of iron now before you. I wish to draw your attention to the long and the short lines. The vapour which exists furthest from the core of the arc has a much more simple spectrum than that of the core of the arc itself. The spectrum of the centre consists of a large number of lines; that furthest from the centre consists of one line. If you picture to yourselves the particles getting nearer to each other, as you get nearer the source of supply, you see that the nearer the particles are together the more they hang about and the more lines we get in the spectrum. It is important to notice that vibration once begun always goes on; it never gives *place* to others, although it may give *rise* to others; so that you get the largest number of lines in the centre, where the particles are closest together. Now I have specially to refer to the fact that the way in which the continuous spectrum is built up varies in different substances. Here I have a photograph giving the spectrum of aluminium and calcium compared with that of the Lenarto meteorite. The spectra of calcium and aluminium differ generically from that of the meteorite. I want to draw attention to the thick or winged lines you get in the case of aluminium and calcium. These spectra are good specimens of those which give a continuous spectrum by thickening the lines, while the elements in the meteorite are as good specimens as I could put before you of those which produce a continuous spectrum by increasing the number of their lines.

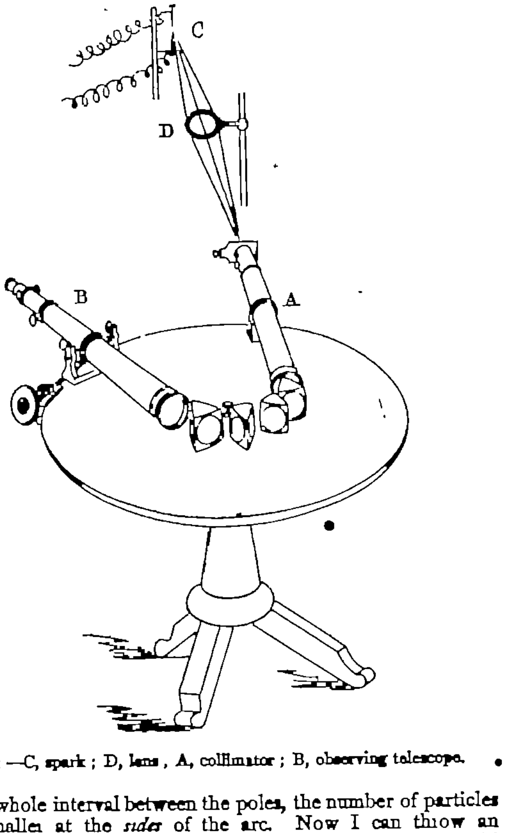


FIG. 1.—C, spark; D, lens, A, collimator; B, observing telescope.

There is another remarkable fact connected with this.

FIG. 2.—Long and short lines of zinc and cadmium

You see a thin dark line in the centre of the thick bright lines; this is due to the absorption by the rarer cooler vapour lying outside this vapour. This is almost invariably observed in the substances giving us the lines thickening as the continuous spectrum is approached, while iron does not give us any such reversal. It is well to see if one can group facts together. That is the first business of a man of Science. It is extraordinary that in all the substances I have yet examined the question of specific gravity decides whether the substance should have its spectrum complicated by thickening or increasing its lines. You know the specific gravity of iron is high. In the case of aluminium, magnesium, sodium, and others where this is low you have the widening of the lines and the easy reversal.

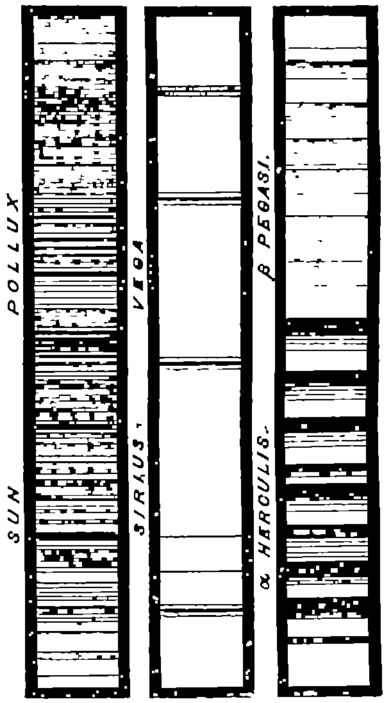


FIG. 3.—Long and short lines of iron.

So much for the continuity of the spectroscopic record of the continually increasing distance of particles from particles. We began with a solid and a continuous spectrum, we end with a tenuous gas and a spectrum of a single line, and we partly bridge over the gap between these states in two different ways.

J. NORMAN LOCKYER

(*To be continued.*)

COL. GORDON'S JOURNEY TO GONDOKORO

WE have been favoured with the following remarks concerning Colonel Gordon's journey to Gondokoro. Colonel Gordon, "His Excellency, the Governor-general of the equator!" arrived at Khartoum on March 13, and had with him a *Pall Mall Gazette* of Feb. 13; he writes on the 17th from Khartoum as follows:—

"At this season of the year the air is so dry that animal matter does not decay or smell, it simply dries up hard; for instance a dead camel becomes in a short time a drum.

"The Nile, flowing from the Albert Nyanza below Gondokoro, spreads out into two lakes; on the edge of these lakes aquatic plants, with roots extending 5 ft. into the water, flourish; the natives burn the tops when dry, and thus form soil for grass to grow on; this is again burnt, and it becomes a compact mass. The Nile rises and floats out portions, which, being checked in a curve of the channel, are joined by other masses, and eventually the river is completely bridged over for several miles, and all navigation is stopped.

"Last year the governor of Khartoum went up with three companies and two steamers, and cut away large blocks of the vegetation; at last one night the water burst, the remaining part, and swept down on the vessels, dragging them down some four miles, amidst (according to the Governor's account) hippopotami, crocodiles, and large fish, some alive and confounded, others dead or dying, the fish being crushed by the floating masses. One hippo was carried against the bows of the steamer and killed, and crocodiles 35 ft. long were killed: the Governor, who was on the marsh, had to go five miles on a raft to get to the steamer.

"The effect of these efforts of the Governor of Khartoum is that a steamer can now go to Gondokoro in twenty-one days, whereas it took months formerly to perform the same journey."

Colonel Gordon left Khartoum on March 21, and in his last letter from Fashoda, 10° N., he touches on some of the scenes on the banks of the river—the storks, which he was in the habit of seeing arrive on the Danube in April, laying back their heads between their wings and clapping their backs in joy at their return to their old nests on the houses, now wild and amongst the crocodiles 2,000 miles away from Turkey; the monkeys coming down to drink at the edge of the river, with their long tails, like swords, standing stiff up over their backs; the hippos and the crocodiles. Such scenes to a lover of nature, as Col. Gordon is, doubtless would serve to make up in some measure for the loss of civilised society and comforts.

THE EXTINCT FAUNA OF THE MASCARENE ISLANDS*

THE members of the scientific expedition about to start for Rodriguez should make themselves acquainted with what has already been done towards the working out of its wonderful extinct fauna. We therefore beg leave to call their attention, and that of naturalists in general, to a recent contribution of M. Alphonse Milne-Edwards to our knowledge of this subject, published in the "Annales des Sciences naturelles."

In this excellent memoir M. Milne-Edwards describes the objects disinterred during some researches made in the caverns of Rodriguez under the direction of Mr. Edward Newton, the Colonial Secretary of Mauritius, as also the contents of a small collection from Mauritius itself, made in the same recent formation whence the complete skeletons of the Dodo were latley obtained.

The remains described and figured are entirely those of Birds, to the extinct forms of which class the author of this memoir has lately devoted so much of his attention. The most remarkable form thus restored to us is certainly the rail-like bird, apparently allied to the *Ocydromus* of New Zealand, which is proposed to be called *Erythromachus leguati*. This bird is of greater interest, as there can be little question that it is the *Gelinote* of which the old voyager Leguat speaks, as abundant in the island 200 years ago, and as being "grasse pendant toute l'année et d'un goût délicat," although we cannot quite understand how the pectoral muscle can have been sufficiently large to provide much sustenance to the hungry mariners of those days! Besides the *Erythromachus*, M. Milne-Edwards resuscitates species of owls, pigeons, parrots, and herons, and concludes his useful memoir with some pregnant remarks upon the general character of the ancient fauna of the Mascarene Islands.

We trust that the new expedition, soon about to start for Rodriguez, will not fail to succeed in obtaining a much more intimate acquaintance with both the ancient and modern fauna of this remote island.

---

* "Recherches sur la Faune ancienne des Iles Mascareignes." Par M. Alph Milne-Edwards. Ann. Sc. Nat., sér. 5 Zool., t. xix.

NOTES

THE annual meeting of the Linnean Society was held on Monday, in conformity with the terms of the charter, when Prof. Busk presided. The following officers were elected:—President, G. J. Allman, M.D.; Treasurer, Daniel Hanbury; Secretaries, Frederick Currey; and St. George J. Mivart. The five members of the present Council recommended to be removed were—Dr. Braithwaite; J. D. Hooker, C.B., M.D; J. G. Jeffreys, LL.D.; Daniel Oliver; W. W. Saunders. The five Fellows recommended to be elected into the Council in the room of the above were—Major-Gen. Strachey; W. T. T. Dyer; J. E. Harting; W. P. Hiern; J. J. Weir.

THE Annual Report, dated Jan. 31, 1874, of Mr. Gould, Government Astronomer to the Argentine Republic, has come to hand, containing an account of the work done at Cordoba Observatory during the past year. Judging from this and the previous report, and from the amount of encouragement given to Mr. Gould by the Argentine Government, it seems likely that Cordoba Observatory will produce as valuable results as any other observatory in the southern hemisphere. The observations of the stars between 23° and 80° of S.D. have been diligently continued, the heavens for this purpose being divided into a number of zones of convenient size. More than 70,000 observations of stars have in this way been made, and Mr. Gould confidently hopes that by the middle of this year the zone-observations will be completed, by which time he calculates that about 65,000 different stars will have been observed. Besides this a large number of observations for instrumental corrections have been made, besides repeated and careful observations of five or six stars in each zone for the purpose of detecting any errors of observation in the other stars of the zone. A considerable amount of photographic work has also been done, though Mr. Gould has been sadly hampered in this department. A variety of other useful astronomical work has been done at the observatory, which, under Mr. Gould's superintendence and by the liberality of the Argentine Government, is being gradually brought to a condition of great efficiency.

Mr. Gould is also provisional director of the Argentine Meteorological Office, which has been established for only about two years; here also he has set to work in a thorough manner with results that promise well for the future, notwithstanding the difficulties that have met him in the getting together of good instruments. He has endeavoured to collect all the meteorological observations on record, made at any time in any portion of the national territory or its immediate vicinity; and very excellent progress has been made in this direction. He has also enlisted coadjutors to make systematic observations in various parts of the country, and soon he hopes to have the country well dotted with such observers. A considerable amount of work has been accomplished in tabulating and computing the results thus far collected. By the end of another year it is expected that sufficient observations will be available to permit the publication of a volume devoted exclusively to the meteorological statistics of the Argentine Republic.

DR. BURMEISTER, well-known for his thorough knowledge of the natural history of the region of La Plata, where he has resided for many years, has been, we learn from the *Academy*, nominated to the post of Director of the Natural History and Physical Faculty of the University of Cordova, where seven chairs are already held by German professors.

THE delegates of the Oxford University Museum have appointed Mr. H. J. Stephens Smith, M.A., Balliol College, Fellow of Corpus Christi College, to the keepership of the University Museum, vacant by the lamented death of Prof. Phillips. The stipend of the keeper is 80*l.* per annum, with an official residence adjacent to the museum. The appointment of Mr. Smith will have to be ratified by convocation. The Professorship of Geology, vacant also by the demise of Prof. Phillips, and worth 300*l.* per annum, is still vacant, though no official announcement of the vacancy has been made.

THE first party of the English expedition for observing the transit of Venus took its departure on Saturday afternoon in the Government transport *Elisabeth Martin*, from Woolwich. The stores include cases of astronomical and photographic apparatus to the extent of nearly 150 tons measurement, besides provisions and other necessaries, as some of the party will be for several weeks located in inhospitable regions. Of the gentlemen who left on Saturday, Lieut. Neate, R.N., will be chief astronomer at Rodriguez, in the Indian Ocean, and Lieut. Hoggan, R.N., one of his assistants; Lieut. Goodridge, R.N., one of the astronomers at Christmas Harbour, Kerguelen, which lies between the Cape and Australia; Mr. J. B. Smith, astronomer and photographer at the same station; and Lieut. Cyril Corbett, C.B., is to be chief astronomer at a second station in the same island. There are to follow—Mr. Burton, astronomer and photographer at Rodriguez; the Rev. F S. Perry, F.R.S., chief astronomer at Christmas Harbour; the Rev. W. Sidgreaves, astronomer at the same station; and Lieut. Coke, R.N, who will act as astronomer with Lieut. Corbett at the second station, Kerguelen.

WE greatly regret to hear that the Rev. R. T. Lowe, the well-known author of a "Flora of Madeira," was among the passengers who lost their lives in the recent wreck of the *Liberia*.

THE French Academy has elected M. de Tchebycheff, the eminent geometer of St. Petersburg, foreign associate, in place of the late M. De la Rive, and M. Ollier of Lyon, a corresponding member in place of the late Dr. Guyon.

SCIENCE is beginning to make headway in the re-constituted University of Strasburg. A new observatory (under the direction of Prof. Winnecke) is to be commenced at once, and an 18-inch refractor has been ordered. The Physical Cabinet (under the direction of Prof Kundt) already possesses a very fine collection of the newest apparatus, and the professor has a class of fifty men.

IN a small pamphlet, reprinted from the *Wiener Abendpost*, Karl von Littrow takes advantage of the foundation of the new observatory of the Vienna University to give a history of the old observatory, which has been in existence for more than a century, and of some of the work which has been done in it. The new observatory has apparently been carefully planned, and will be well provided with the most approved instruments.

WE would draw attention to the valuable Notes concerning the work of the *Challenger* between Simon's Bay and Melbourne, in the *Times* of Monday and Tuesday. Very important observations have evidently been made on the currents, temperature, and life of the southern seas. Some interesting observations are made regarding icebergs, and the remarkable similarity of the fauna of the southern seas to that of the northern is noticed. "We scarcely expected," the writer says, "to find the water so deep, but it agrees with our former observations, which lead us now always to expect to find the deepest water near the land. To account for this we can only reason that no large part of the surface of the earth can be raised higher than another by means of a volcano or otherwise, unless at the same time a corresponding hollow or depression is excavated in the neighbourhood. To form a hill, the earth must be removed from somewhere else."

PROFS. DONDERS and Th. W. Engelmann have published, in Dutch, the results of their inquiries made during 1873 on the passage of blood-cells through the vessel. Working with a unilocular microscope, they have not been able to find any aperture by which the white corpuscle can pass through the vessel.

THE last number of the *Journal of Botany* contains a sketch by Mr. B. D. Jackson of the life of William Sherrard (1658-1728). Mr. Jackson's object is thus stated:—"The whole life of William Sherrard was so intimately connected with that of the leading men of Science in his day, that a comprehensive account of his career would be an epitome of his times. The exigencies of space, however, forbid more than a sketch of his life, designed to correct certain errors which appear in all the accounts that have come under my notice, copied apparently from one book into another." Mr. Jackson says of him:—"Whilst we cannot admit him as the equal of his contemporaries, Ray and Tournefort, who originated systems, yet the services he rendered to botany at a period termed by Linnæus 'the golden age,' must make his name as lasting as the science. His intercourse with the leading men in the science both at home and abroad was intimate and frequent; he was generous even to excess in distributing seeds and dried plants, an unfailing patron of deserving naturalists, and crowned his useful life by the bequest of his library and herbarium (the most authentic and one of the largest at the time) to the University of Oxford, with the endowment of 3,000*l.* for the professor of botany."

WE are glad to learn that the anticipations expressed in one of our recent numbers as to the management of the future office for Maritime Meteorology in Germany, have been fulfilled by the appointment of Herr W. von Freeden to the post of director Herr von Freeden was for many years at the head of the Navigation School at Elsfleth, near Bremen, and since 1867 has superintended the Seewarte at Hamburg. The best results may be hoped for from his long experience and his known zeal for Science.

IT is requested that those members of the University of Cambridge who desire to avail themselves of the facilities for study at the zoological station at Naples, for which a grant has been made from the Worts Travelling Bachelors' Fund, will send their names to Mr. Foster, Fellow of Trinity College, on or before October 1. The nominations will be made by the Board of Natural Science Studies early in October.

AN expedition is being fitted out for an exploration of the Arctic Seas. Capt. Wigans, Sunderland, has engaged Mr.

Lamond's splendid steam yacht *Diana*, and will proceed *viâ* Nova Zembla, sailing from Dundee on June 1. Capt. Brown, Peterhead, will command the *Diana*.

ON the 20th inst. a large representative meeting of various corporate towns was held at the Society of Arts, Adelphi, under the presidency of Lord Hampton, in reference to the national museums. The following resolutions were passed unanimously :—1. "That all museums and galleries supported or subsidised by Parliament should be made conducive to the advancement of education and technical instruction to the fullest possible extent, and that special Parliamentary funds should be granted to assist local and provincial museums in the acquisition and loan of objects, and with building grants, and thus extend their usefulness." 2. "That in the opinion of this meeting all national museums and galleries should be placed under the authority of a Minister of the Crown, with direct responsibility to Parliament, thereby rendering unnecessary for the purposes of executive administration unpaid and irresponsible trustees except those who are trustees under bequests or deeds, who might continue to have the full powers of their trust, but should not be charged with the expenditure of money voted by Parliament." The chairman was requested to submit to the Prime Minister the foregoing resolutions, and press their importance on his attention.

WE cannot regret that Lord Hampton's motion for the appointment of a Minister of Education in the House of Lords last Friday was lost. Lord Hampton does not seem to understand what is really required, and the Duke of Richmond's reply under the circumstances was perfectly appropriate and conclusive.

IT is known that several years ago the German Astronomical Society undertook the systematic revision of star catalogues for the boreal hemisphere up to the 9th magnitude. That heavy task has been undertaken by fourteen observatories—Cambridge (England), Christiania (Norway), Palermo (Italy), Neufchâtel (Switzerland), Leyden (Netherlands), Harvard College and Chicago (U.S.), Pulkowa, Dorpat, Helsingfors, Kazan (Russia), Berlin, Leipzig, Bonn (Germany). The boreal hemisphere has been divided into zones, each of which has been allotted to two different observatories. Pulkowa was entrusted with the care of observing fundamental stars numbering 539. The work is just half done, and will be finished by the end of 1875, when every star marked by Lalande in his "Histoire celeste," and Argelander in his star catalogue, will have been revised.

A CHOLERA conference is to meet in Vienna in the course of the autumn, to discuss the best methods of preventing the propagation of the disease. Prof. Pettenkofer, who has carefully watched the progress of cholera in Munich since its outbreak nearly a year ago, will be present, and will no doubt have valuable information to contribute. The number of deaths, which last winter amounted to 55 a-day in Munich (as a maximum), had sunk last month to 2 per diem.

THE German Society of Anthropology is industriously collecting material for the Prehistoric map, which it was resolved, at the meeting of April 1870, to prepare for publication. Among other points to be indicated on this map will be the position of the most notable Prehistoric settlements, fortifications, lake-dwellings, cave-dwellings, burial-mounds, and other places of sepulture. By a judicious use of colours, the various periods—Stone, Bronze, and Iron—will be indicated, and altogether the map will be one of great value to the student of archæology and ethnology.

WE have already referred to the treatment by the French Government of M. Alglave, Professor in the Law Faculty of Douai, and editor of *La Revue scientifique*. M. Alglave had been delegated temporarily to the faculty of Grenoble, but as he had undertaken to deliver a course of lectures at Lille, and had moreover been designated secretary to the approaching session of the French Association at that town, he petitioned the minister to permit him to remain at Douai; the reply was absolute dismissal from his post without delay. Such is a specimen of how French ministers use their "little brief authority."

LAST Thursday a handsome new aquarium, well stocked with marine and fresh-water fish, was opened at Manchester. The sea-water is brought by train in barrels from Blackpool, a distance of about 40 miles, and a constant supply is maintained.

MR. J. W. DOUGLAS, the well-known entomologist, has become one of the editors of the *Entomologist's Monthly Magazine*.

THE first part of the third issue of Sowerby's "British Wild Flowers" (Van Voorst) is now out; the descriptions with an Introduction and a Key to the Natural Orders, being by C. Pierpoint Johnson, Botanical Lecturer at Guy's Hospital.

THE additions to the Zoological Society's Gardens during the last week include a Wild Boar (*Sus scrofa*) from Algeria, presented by Mr. W. F. Tempest; an Ourang-outang (*Simia satyrus*) from Borneo, deposited; a Racoon-like Dog (*Nyctereutes viverrinus*) from Amoorland, new to the collection; a Great Bustard (*Otis tarda*), European; five Red-legged Falcons (*Erythropus vespertinus*), European, purchased; three Temminck's Tragopans (*Ceriornis temmincki*) and three Peacock Pheasants (*Polyplectron chinquis*), hatched in the Gardens; and two Hairy Armadillos (*Dasypus villosus*), born in the Gardens.

THE FLORENCE INTERNATIONAL BOTANICAL CONGRESS

THE International Botanical Congress commenced its sittings at Florence on May 15, under the presidency of Dr. Hooker, Prof. Parlatore being disabled by illness from filling that post. The vice-presidents elected were Mr. Bentham and Dr. Moore for Great Britain, M. de Candolle for Switzerland, M. Fenzl for Austria, MM. Planchon, Weddell, and Baillon for France, MM. Reichenbach, Hofmeister, Wendland, and Karl Koch for Germany, and MM. Regel, Bunge, Gelernoff, and Wolkenstein for Russia. At the Congress England was represented by Professors Bentham, Allman, and Masters, Drs. Hooker and Ball, Messrs. Smee, Hiern, and Maw; David Moore represented Ireland, and Charles Moore Australia.

On the first day a paper was read by Dr. Planchon on *Phylloxera vastatrix* and the vine disease; on vegetable palæontology by M. Carnel; on the development of *Cynomorium coccineum*, by Dr. Planchon; M. Famintzin on the spores of *Aethalium*.

At the second meeting, May 18, Prof. de Candolle presided, and among the papers read was one by Mr. W. P. Hiern, of Cambridge, on the determinations of the fossils that have been referred to *Diospyros* or allied genera. At the third meeting, May 20, Dr. Bunge, a Russian botanist, presided, and the papers included one by De Candolle on Alpine plants. On the 16th took place the inauguration of the bust of Philip Barker Webb, an English botanist, who left his valuable herbarium to Florence. An oration was made by Dr. Bolt, of Berlin.

The International Horticultural Exhibition, which took place concurrently with the Congress, was opened by the King on the 15th, and the following day 1,800 people were present.

The show was held in a new iron building in the middle of the town, which is to be used as a market. The *Italian News*, published in Rome May 19, says: "The Floral Exhibition has proved a decided success, in spite of the bad weather which accompanied its inauguration. There has been a large daily attendance. The show was remarkably complete, and the prizes have been awarded with such justice that no jealousies have been allowed to mar the pleasure of the recipients."

It is proposed that the conference for next year shall be held in London.

SCIENTIFIC SERIALS

THE *Geographical Magazine*, May.—The principal article in this number is a translation by Col. Yule, C.B., of some of the notes appended to the Russian edition of his "Essay on the Oxus," by the late Alexis Fedchenko; they are extremely interesting.—Mr. E. D. Morgan contributes a paper on the new Russian province of Amu Daria, which is accompanied by a map.—Mr. E. G. Ravenstein's paper On the Viti or Fiji Islands, with the excellent map which accompanies it, will be very acceptable to many at the present time.—The number contains a very curious and interesting paper purporting to be the autobiography of a slave, under the title of My parentage and early career as a slave.

THE *Geological Magazine* for May, contains the following original articles:—The shell-bearing gravels near Dublin, by the Rev. Maxwell Close, F.G.S.; On some new Devonian fossils, by Prof. H. Alleyne Nicholson, F.R.S.E.; On the substitution of zinc for magnesium, by E. T. Hardman, F.R.G.S.I.; The volcanic history of Ireland—address to the Royal Geological Society of Ireland, by Prof. Hull, F.R.S., president; On a raised beach at Tramore, by E. T. Hardman.

THE *American Journal of Science and Arts*, April 1874.—We have here the continuation of Prof. Leconte's interesting paper On the great lava flood of the North West, and the structure and age of the Cascade mountains. There has been much speculation as to the origin of the "prairie mounds," which consist of a drift soil of earth, gravel, and small pebbles. Prof. Leconte considers they are entirely the result of surface erosion acting under peculiar conditions, viz. a treeless country and a drift soil consisting of two layers, a finer and more movable one above, and a coarser and less movable one below.—Mr. Chase gives an account of the auriferous gravel deposit of Gold Bluff.—Mr. Meek continues his notes on some of the fossils figured in the recently issued fifth volume of the Illinois State geological report; and Mr. Verril gives results of recent dredging expeditions on the coast of New England.—In a paper On the lignites and plant-beds of western America, Mr. Newberry calls in question some of Mr. Lesquereux's conclusions, and seeks to show that several of the beds are Cretaceous and not Eocene.—Among the remaining matter we find notes on a mass of meteoric iron found at Howard co. Ind. (with remarks on the molecular structure of meteoric iron); on the parallelism of coal seams; and on recent earthquakes. We may also notice, in the Scientific Intelligence, a lengthy abstract of a paper by Josiah Cooke, jun., On the vermiculites, their crystallographic and chemical relations to the micas, with a discussion of the cause of variation of the optical angle in these minerals.

Poggendorff's Annalen der Physik und Chemie, Jubelband.—The hearty co-operation with which the proposal was met, to commemorate the jubilee of the scientific veteran who has for years edited the *Annalen*, is here represented in a collection of more than sixty papers of original research, many of them by well-known investigators. We can do little more than briefly glance at some of the subjects that are treated, of which there is great variety. Electricity and magnetism meet with a considerable share of attention; and we may first of all note some interesting studies, by M. Wullner, on discharges of the induction current in spaces filled with rarefied gases. This research betokens considerable minute care. Variations were made, in the form of the tubes used, degrees of rarefaction, direction of spark, velocity of rotating mirror in which the light was reflected, &c.; the influence of magnets was also observed, and some striking peculiarities of striation in the image of the discharge are brought to light, and shown in drawings.—M. Hittorff examines from a different point of view the conduction of electricity by gases.—Prof. Blaserna, of Rome, studies extra currents; and he points out that at the moment of closure the current begins to flow, first slowly, then more quickly, till it reaches a maximum, from which it descends, by a series of oscillations, between maxima and minima, to zero.—M. Reiss, in reference to what he terms the electric induction of a non-conductor in itself, enunciates the proposition that at the under surface of a free non-conducting plate, whose upper surface is electrified, there is an electric layer of the same sign with the electricity of this surface, while immediately above there is an electric layer of the opposite sign.—The heat-action of electric disjunction currents forms the subject of a communication from M. Edlund; and M. Kohlrausch describes the action of polarisation on alternating currents; also a sinus-inductor. The electromotive force of liquid batteries, the thermo-electric properties of topaz, spar, and arragonite, the action of magnets on discharges in rarefied gas, the conductivity of glass for electricity and heat, and some peculiarities of galvanic polarisation, are also treated; and of the more theoretical papers, we may specify one by Prof. Feilitzsch, On the poles of equal normal intensity in the magnetic field of a galvanic battery current, and one On a general theorem for calculating the action of magnetising spirals, by Dr. von Waltenhofen.—Perhaps no scientific serial presents such a rich collection of material in the department of mineral chemistry as *Poggendorff's Annalen* during these fifty years. The influence of Berzelius has made itself powerfully felt; both his spirit and his method being evidently reflected in the researches by his students, among whom Prof. Heinrich Rose occupies the first rank. Those who are interested in this branch will find in the *Jubelband* a valuable *résumé*, by Prof. Rammelsberg, of the work of the *Annalen* in reference to it; and a list is given of forty young chemists who have laboured on various mineral forms, under Rose's direction.—In a paper On the struggle for existence among molecules, by M. Pfaundler, an ingenious parallel is drawn between the phenomena of production of certain chemical compounds through partial dissociation and reciprocal reaction, on the one hand, and production of species through natural selection (according to Darwin's theory) on the other; and this article is followed by one On the equivalent of *vis viva*, by M. Wilhelm Weber.—The phenomena of light and heat are studied in various aspects. In a note On the spectrum of aurora, Prof. Angstrom considers that the yellow light (characteristic of all auroras) arises from fluorescence or phosphorescence. An electric discharge is supposable, which, though in itself faintly luminous, is rich in ultra-violet light, and is thus capable of producing strong fluorescence. It is also known that oxygen, and several compounds of it, are phosphorescent. Prof. Angstrom thinks it unnecessary to have recourse to "variability of gas-spectra under varying conditions of pressure and temperature."—M. Zollner has a paper of photometric researches on the physical character of the planet Mercury, in which he comes to the conclusion that Mercury has a surface closely resembling that of our moon; it is without an atmosphere.—Mr. Bolzmann studies the connection between the turning of the plane of polarisation and the wave-length of various colours; M. Ketteler, the specific law of so-called anomalous dispersion; M. Knoblauch, the reflection of heat and light rays from inclined diathermanous and transparent plates; and M. Dufour the reflection of solar heat from the Lake of Geneva.—A curious phenomenon is discussed by Prof. Lommel, viz. the appearance of a luminous halo round the shadow of one's head in wet grass, especially when the sun is low. He supposes it to arise from light being refracted through the drops, received by the surface below, and sent back through the drops to the luminous source; the light thus suffering a fourfold refraction, and also a diffuse reflection. It is a like cause to that which explains the shining of cats' eyes in the dark.—In experimenting on the specific heat of water at various temperatures, M. Bosscha arrives at results somewhat different from those of Regnault.—M. Hagenbach continues his experiments on fluorescence.—There are several papers referring to new and improved instruments. The practical physiologist will be interested in some new arrangements, by Dr. du Bois Regmond, for studying the physics of nerve and muscle, including a mercury key, a double commutator, a "frog pistol," and a spring myographion.—M. Barentin describes an improvement on Poggendorff's machine for demonstrating acceleration; M. Gorst a spectroscope with fluorescent eye-piece; M. Melde a wave-apparatus for showing Chladni's sound-figures; M. Rudorff an improved Bunsen photometer; while M. Jolly makes a new determination of the expansion coefficients of some six gases, and investigates the action of air thermometers.—The theoretical limits of capability of the microscope forms the topic of an able memoir by M. Helmholtz.—Some hydraulic researches by M. Meyer prove that pressure is propagated in water with the velocity of sound; and that the Poisseuille law holds good for outflow of water not only through capillary tubes, but also through wider tubes, provided these are sufficiently long (thus it was found to hold for 250 to 3,000 m. length in a tube 7 mm. diameter).—M. Karsten communicates an instructive account of recent scientific researches on the temperatures, saltness, &c., of the Baltic and North Seas.—In mechanics we have a number of bending-experiments from M. Buff, in reference to elasticity of various substances—iron, glass, wood, &c.; and among the few chemical subjects treated (not to prolong our enumeration) are the constitution of chlorhydric acid and its salts (Thomsen), new sulphur salts (Schneider), and the volume constitution of some oxides (Schröder).—The only paper from an English source appears to be that of Prof. Tyndall's, On propagation of sound through the atmosphere.—A well-executed portrait of Prof. Poggendorff is prefixed to this interesting volume.

Astronomische Nachrichten, Nos. 1,984, 1,985, and 1,987.—These numbers contain a long paper by Prof. E. Kayser on some new applications of the level to astronomical instruments, especially to the alt-azimuth.—A table of the eclipses of Jupiter's satellites, observed at Toulouse from Jan. 4 to April 1, appears in No. 1,985.—Observations of planets 135 and 136, are given by H. G. von der Sande Bakhuyzen, J. Paliser, and E Stephan.—No. 1,987 contains a paper by C. Hornstein, On the daily variation of the horizontal magnetic force of the earth. The author points out the correspondence between the sun-spot period and the variation above mentioned, the maximum and minimum of each, according to the table, appears to occur at the same time.—R. Luther gives a number of observations on the positions of the minor planets and variable stars. The elements of Winnecke's comet are given by W. Schur as follows:—

T = March 14·0356 Berlin mean time
☊ = 274° 7′ 5″
Π = 302° 15′ 41″
ι = 31° 32′ 26″
log. q = 9·947502.

Prof. Winnecke communicates the discovery of the above comet.—Prof. Weiss gives an ephemeris of Winnecke's comet I. Position for May 18, R.A. 15h. 22m. 15s., D. + 43° 8′, decreasing in R.A. about 15′ a day, and increasing in D. a few minutes.—C. Bruhns gives positions of Winnecke's and Coggia's comets.—Dr. J. Holetschek gives an ephemeris for Coggia's comets as follows:—

12h. Berlin time.

	R.A.			D.	
	h.	m	s.	°	′
May 23,	6	13	38	+ 67	21·0
June 4,	5	51	14	+ 63	9·5
,, 16,	5	12	0	+ 47	5·0
,, 28,	4	49	50	+ 11	6·1

Prof. Peters, A. de Jasparis, and G. Bumher also give observations on the two above-mentioned comets,

Journal de Physique, April.—This number begins with a note in which M. Desains describes an improved method of studying Newton's coloured rings; the plane is made movable to and from the lens by means of a fine micrometric screw, so that the pressure can thus be varied; and the rings are observed with monochromatic light, either direct from a flame, or isolated from the spectrum.—In a paper On transformation of optical achromatism of object-glass into chemical achromatism, M. Cornu finds that, given an achromatic astronomical telescope, the object-glass of which is formed of a convergent lens of crown glass and of a divergent lens of flint glass, this object-glass may be transformed into one capable of giving satisfactorily distinct photographic images, by separating the two lenses to an extent dependent on the nature of the two glasses. With the glasses used in optics, a separation of 1½ per cent. of the focal distance of the object-glass is sufficient, and the chemical focus is very near the optic focus. The aberrations produced by this separation may, the author thinks, be entirely neglected. Using an excellent telescope 100 mm. aperture and 1·40 m. focal distance, and separating the two glasses 15 mm. he succeeded in photographing a scale, divided into millimetres, placed at 40 metres distance; the lines were quite distinct; the relation of the empty spaces to those filled in was quite recognisable, and with a microscope and micrometer it was possible to measure the thirtieth part of the intervals.—This paper is followed by the first part of one in mathematical physics, in which M. Blavier studies the electric resistance of the space inclosed between two cylinders.—A new rheostat is described by M. Crova, in which two platinum wires pass down to the bottom of a long graduated tube containing mercury, the height of which can be varied through elevation or depression of a spherical vessel communicating with the bottom of the glass tube, through a tube of caoutchouc.—There are, further, notices of M. Seebeck's recent researches on motion of sound in bend and bifurcating tubes, M. Dufour's on reflection of solar light at the surface of Lake Leman, &c.

Bulletin Mensuel de la Société d'Acclimatation de Paris.—The February number of this *Bulletin* commences with a paper by M. Decroix, on the consumption of horse-flesh in France, as meat, from which it appears that hippophagy is largely on the increase.—The question of silkworm culture again occupies a prominent position in the report, and a statement of the services rendered by acclimatisation in Egypt is very interesting. The *Eucalyptus globulus*, the cocoa tree, the silkworm, the *Cytisus cajan* of Madagascar, or Ambrevade, are among the recent acquisitions of that country.—The cultivation of tea in Java is the subject of a valuable paper by M. E. Prillieux; in 1826 the first seeds of the tea-plant were sown in that island; and in 1867 the annual production was 1,600,000 lb. The very best qualities often thrive in that country.—The introduction of the African ostrich into France is proposed. The plumage of a male ostrich is valued at from 300f. to 500f. (12*l*. to 20*l*.); that of a female at about half that, while the plumage of the American ostrich is sold at 15f. to 20f. the kilogramme (12*s*. to 16*s*. per 2 lb.)—The system of oyster-culture, till recently so successfully adopted in France, is threatening to collapse; and some valuable hints thrown out by M. D. de Mayréna may be of service in assisting to arrest the decay.—In the Jardin d'Acclimatation 335 mammalia and 2,647 birds were received during January and February, amongst which were a new monkey, *Lemur catta*, two St. Hubert bloodhounds, some Viellot's pheasants of Java, two emus, a very fine ostrich, and an Indian duck (*Anas pacilorhynca*), a curious-looking bird, with a beak orange at the root, black in the middle, and pure white at the tip; the plumage is a grey colour.

Bulletin de l'Academie Royale de Belgique, No 3, 1874.—This number opens with a tribute to the memory of M. Adolphe Quetelet, in the form of six discourses delivered at the funeral of that eminent *savant* on Feb. 20 last, by MM. Keyser, Ed. Mailly, &c., representing various learned Societies.—In the department of Science we find an account of M. Louis Henry's continued researches on diallylic derivatives. In a previous paper he had shown that allylic compounds combine directly with hypochlorous acid to produce glyceric compounds; and he here extends the observation to diallylic compounds, diallyl having been found to combine directly with hypochlorous acid and form a diallylic dichlorhydrine.—In a second note of researches on camphor, M. Dubois describes an advantageous mode of preparing brominated camphor. It rests on the previous formation of an additional brominated product, $C_{10}H_{16}OBr_2$; which is then decomposed into brominated camphor and bromhydric acid, $C_{10}H_{15}BrO + BrH$. Among the numerous products obtained from action of iron, heated red, on camphor-vapour, M. Dubois finds a terpene $C_{10}H_{16}$, which he regards as important with reference to the composition of camphor.

Archives des Sciences Physiques et Naturelles, April 15.—This number commences with a chemical paper, by M. Eugene Demole, On distillable oxygenated bases derived from glycol and aromatic amines. It appears that when a primary amine is in presence of oxide of ethylene it is not a molecular combination that is produced, but a true product of substitution of glycol. The secondary base which thus forms possesses still a hydrogen replaceable by alcoholic radicals, and the product of this substitution is a tertiary base; which, again, is susceptible of the addition of alcoholic iodides to form quaternary iodides indecomposable by alkalis.—In the next paper, M. Dufour studies the phenomenon which occurs when two masses of air, differing in hygrometric state, are separated by a partition of porous earth; a diffusion takes place, in which the more abundant current passes from the drier to the more humid air. The activity of diffusion depends on temperature only indirectly, in so far as this occasions difference of vapour-tension on the two sides of the partition. It depends little, if at all, on fraction of saturation. The difference between the quantities or tensions of water-vapour on the two sides is the important element; the diffusion is nearly proportional to this difference.—A spectroscope with fluorescent ocular is described by M. Soret. The method consists in placing a plate of a transparent and fluorescent substance (uranium glass, or a fluorescent liquid between two thin plates of glass) in the eye-glass of a spectroscope, at the focus of the object glass, and observing the spectrum with an ocular inclined to the axis of the eye-glass. It is specially applicable to solar light, and renders distinctly visible the spectrum from H to N, without the necessity of working in a dark chamber. It is less delicate than the photographic method, but much quicker.—M. Achard investigates the action of differential manometers with two liquids.

SOCIETIES AND ACADEMIES

London

Zoological Society, May 19.—Dr. E. Hamilton, vice-president, in the chair.—Mr. Sclater exhibited a skin of the new Japanese Stork (*Ciconia boyciana*), and read an extract from a letter recived from M. Taczanowski, relating to its occurrence in the Amoor territory.—Letters were read from Dr. W. Peters relating to the locality of *Periodogaster grayi*, and from Dr. Hector containing a correction to his article on *Cnemiornis*, published in the Society's "Proceedings."—Prof. Newton exhibited and made remarks on two original letters, the property of Dr. J. B. Wilmot, written from Mauritius in 1628, and referring to the Dodo.—A communication was read from Mr. G. E. Dobson, containing an account of some experiments made on the respiration of certain species of Indian fresh-water fishes.—A communication was read from Mr. W. H. Hudson, containing an account of the habits of the Burrowing Owl (*Pholeoptynx cunicularia*) of the pampas of Buenos Ayres.—Two communications were read from Mr. W. C. McIntosh. The first of these was entitled "Contributions to our Knowledge of the British Annelida;" and the second contained the first portion of an account of the Annelida collected during the *Porcupine* expeditions of 1869 and 1870.—A communication was read from Dr. J. E. Gray, F.R.S., containing a list of the species of feline animals (*Felidæ*).—A second communication from Dr. Gray contained the description of a new species of Cat from Sarawak, proposed to be called *Felis badia*.—A communication was read from M. L. Taczanowski, entitled "Description d'une nouvelle espèce de *Mustela* du Pérou Central."

Geological Society, May 13.—John Evans, F.R.S., president, in the chair.—The following communications were read:—Note on some of the generic modifications of the Pleiosaurian pectoral girdle, by Harry G. Seeley, F.L.S. The restorations and interpretations of the Pleiosaurian pectoral girdle given by Conybeare, Hawkins, Owen, Huxley, Cope, and Phillips, were discussed and reasons given for dissenting from their views. The old genus *Plesiosaurus* was divided into two families, the Pleiosauridæ, containing the genus *Plesiosaurus*, and the Elasmosauridæ, with *Eretmosaurus*, *Colymbosaurus*, and *Murænosaurus*. A new type was taken for the genus *Plesiosaurus*, which showed distinct clavicles. *Eretmosaurus* has neither clavicle nor interclavicle, and the scapulæ, concave in front, are blended in the median line, and blended laterally with the coracoids. Its type is *Plesiosaurus rugosus* of the Lias. *Colymbosaurus* has for its type *Plesiosaurus megadeirus* of the Kimmeridge clay. It has no inter-clavicle, the scapulæ are prolonged forward in a wedge and backward, so as to meet the coracoids in the median line, and inclose two coraco-scapular foramina. *Murænosaurus* is founded on a new type from the Oxford clay. It has no interclavicle, but the scapulæ are prolonged forward to meet in the median line; they are not prolonged backward to meet the coracoids, hence but one coraco-scapular foramen is formed. A similar condition marks the pelvic girdle.—*Murænosaurus leedsii* Seeley, a Pleiosaurian from the Oxford clay (Part I.), by Harry G. Seeley, F.L.S. All parts of the animal, except teeth, ribs, and hind limbs, were described. The pre-maxillary bones extend bird-like between the nares to the frontals. The foramen parietale is between the parietal and frontal, and directed backward. The cerebral lobes of the brain have a chelonian form, are prolonged in olfactory nerves, like those of *Telesaurus*, and have the optic lobes moderately developed. The exoccipital bones do not enter into the occipital condyle. The basisphenoid is perforated by the carotids, as in *Ichthyosaurus*. The hypoglossal nerve does not perforate the exoccipital bone. There are 44 cervical, 3 pectoral, 20 dorsal, 4 sacral, and the first 8 caudal vertebræ preserved.—On the remains of *Labyrinthodonta* from the Keuper Sandstone of Warwick, preserved in the Warwick Museum, by L. C. Miall. The author considered that *Labyrinthodon ventricosus* Owen is not a distinct species, and that *L. scutulatus* Owen has not been proved to be a Labyrinthodont. The species as identified by the author are as follows:—*Mastodonsaurus jægeri* Von Meyer, *M. pachygnathus* Owen, *Labyrinthodon leptognathus* Owen, *Diadetognathus* (g.n.) *varvicensis*, sp.n.

Chemical Society, April 16.—Prof. Odling, F.R.S., president, in the chair.—Dr. Corfield delivered his lecture On the sewage question from a chemical point of view. The lecturer, after remarking that he was going to consider the question of the value of chemical evidence on the sanitary view of the subject, compared the various systems for treating sewage, all of which might be reduced to two classes; the first, that of conservancy, where more or less of the solid matter was retained in the neighbourhood of habitations, and the other where the whole of the excretal matter was removed along with the foul water by means of sewers. He emphatically condemned the former as poisoning the wells in the neighbourhood and liable to give rise to disease, for it was a fact that the smallness of the death-rate at any large town was proportional to the efficiency of the means used for the removal of the sewage. He subsequently discussed the various methods of rendering sewage innocuous, showing that the only one of any value for this purpose was that of intermittent surface irrigation.

Royal Horticultural Society, May 13.—Scientific Committee. A. Grote, F.L.S., in the chair.—The Rev. M. J. Berkeley exhibited *Claviceps microcephala*, produced by the ergot of *Anthoxanthum*, which generally gave rise to *Claviceps purpurea*. The former species was rufous when fresh but purple when dry, and possibly the two species were not distinct.—Prof. Thiselton Dyer read the following extract from a letter from Dr. Thwaites to Dr. Hooker under date March 31.—"The leaf disease in our coffee is just now in abeyance in the estates I passed by on my way to Newera Eliya, but it is such a treacherous disease in the way of its appearance, and disappearance, and re-appearance, that one cannot predict with any certainty what it is going or not going to do. There cannot be the least doubt that the disease at Tellicherry is the same as what our coffee estates are suffering from (*Hemileia vastatrix*)."—Col. Beddome had heard in India that the leaf disease existed in the Wynaad district (which included Tellicherry), and that it was the same as that of Ceylon.—The Rev. M. J. Berkeley reported that he had carefully examined the leaves of the diseased plants of *Daphne indica* exhibited by Mr. Smee, and that he failed to detect the presence of any organism, vegetable or animal, which could account for the diseased state of the tissues.—Prof. Thiselton Dyer read the following letter from Baron von Mueller:—"From Melbourne will be sent to you by this month's post a dried branch of *Correa lawrenciana*, with flowers as brilliantly red as any of the showiest varieties of *C. speciosa* . . . In my recent journey to Mount Kosciusco from the west, I saw only plants of *C. lawrenciana* with red flowers, whereas on the southern brooks I saw always only the variety with the greenish flowers. Possibly the plant may prove hardy in Britain, as it ascends here to 4,000 feet." Prof. Thiselton Dyer also read the following communication from Mr. Jackson, Curator of the Kew Museum:—"The insects accompanying this were taken from a piece of a trunk of a copal tree (*Trachylobium hornemannianum* Heyne), recently received at the Kew Museum from Zanzibar through the Foreign Office. The wood was for the most part riddled through and through with insect borings, evidently the work of white ants. Mr. Frederick Smith, of the British Museum, to whom I sent some of the living insects, replied:—"The insect you have found in the copal wood is a species of white ant (*Termes*). It appears to belong to the modern genus *Eutermes*, and to be *E. lateralis* Walker. It is extremely interesting to see a living *Termes*, and it is the first time I have done so. There is a European species found in the warmer parts of France and Italy."

General Meeting.—J. A. Hardcastle in the chair.—The Rev. M. J. Berkeley commented on the effects of the late inclement weather. The crop of peas in the neighbourhood of London was practically destroyed. Messrs. Standish sent cuttings of various Japanese plants grown by them at Ascot which had escaped hitherto without injury, while many of the more commonly cultivated shrubs had suffered severely.

Philadelphia

Academy of Natural Sciences, Dec. 16, 1873.—Dr. Carson, vice-president, in the chair.—Remarks on Fossil Elephant Teeth. Prof. Leidy observed that the fossil elephant teeth, presented this evening by Mr. Richard Peters, were obtained by him in Mexico. In appearance the fossils resemble some others, obtained in New Mexico and Chihuahua, referred to in his recent work, "Contributions to the Extinct Vertebrate Fauna of the Western Territories." All appear to have pertained to the coarse-plated variety of molars referred to a species by Dr. Falconer with the name of *Elephas columbi*. Some of the specimens had been found in association with remains of the mastodon, the extinct and near relative of the elephant. The two genera were contemporaneous, and were represented by many species during the middle and later Tertiary periods, but no remains of either have yet been discovered in the early Tertiary deposits. It is probable that both are successors from a common stock which existed at a period intermediate to that in which were formed the known Eocene and Miocene deposits. The molar teeth in the two genera differ in a striking manner, and so widely, that early observers thought those of the mastodon were adapted to a carnivorous habit. That the course of evolution was from the more simple to the more complicated type would appear to be confirmed in the fact that the temporary molars have proportionately shorter crowns and longer roots than in those of the permanent series.

BOSTON, U.S.

Society of Natural History, Dec. 3, 1873.—Prof. John McCrady read a paper on the food and reproductive organs of the oyster, with an account of a new parasite. This parasite apparently destroys, for the time at least, the fertility of the oyster, and to its abundance may perhaps be due the seasons of short spawn, often noticed by those engaged in the oyster culture. The parasite seems to be a new species belonging to the genus *Bucephalus* and may be called *Bucephalus cuculus*.—Prof. Alpheus Hyatt gave a description of his investigation for the past fourteen years upon the Ammonites of the Jurassic period, showing the connection of the forms in the family Arietidæ, and tracing them all to one species, *Amm. psilonotus* of Quenstedt.—Dr. H. A. Hagen read a paper on the origin of the so-called "Tailed Man," often described and pictured by the older authors. In an attempt to copy from a number of old works the figures of this fabulous creature, it gradually became evident that these figures were copies one from another, with slight changes, by the accumulation of which a "tailed man" was gradually constructed. The origin of all these figures is a poor representation of the "Wanderoo" (*Simia silenus* Linn.), given by the old knight, Bernhard von Breydenbach, in his "Voyage to Palestine" in 1486.

VIENNA

Imperial Academy of Sciences, Feb. 5.—Prof. Linnemann made some further contributions towards a knowledge of allyl compounds and acrylic acid. He finds that this acid is completely changed, by sulphuric acid and zinc, at moderate temperature, into propionic acid; also (contrary to present views), that allyl-alcohol, especially in acid solution, takes up hydrogen, and passes into propyl-alcohol.—Prof. Puschl, in a note on specific heat of carbon, offered an explanation of this being different (in the diamond) at different temperatures. He supposes, that for its internal radiation, at ordinary temperature (from the surfaces of the atoms), the diamond is much less opaque than a metal, and that it is more opaque the higher the temperature. Hence the diamond is radiated through by obscure heat, more abundantly the lower the temperature of the source of this; in other words, its opacity for obscure heat increases with the temperature of the source. The same will hold for other kinds of carbon, with this difference, that the opacity of the transparent diamond for a particular kind of direct heat must have a maximum which is not to be looked for in untransparent carbon. He desires that physicists, who have the opportunity, would test the diamond in reference to this point.—M. Puluj gave an account of experiments to determine the constant of friction of air as function of the temperature. According to the theory of gases (with the hypothesis of molecular shocks) the constant referred to must be proportional to the absolute temperature. The author finds it proportional to the ¾ power of the absolute temperature, or $\eta = \eta_0(1 + a\theta)^{\frac{3}{4}}$; which comes nearer to the law than the older determinations by Maxwell and Meyer, and argues the correctness of the hypothesis named.

Feb. 12.—Prof. Dvôrák communicated a memoir on the conduction of sound in gases. He shows how the peculiar acoustical behaviour of hydrogen does not contradict theory, but may be simply explained through resonance. The *vis viva* which the same sounding body, with equal excursions in equal times, gives in different gases, is proportional to the root of the product of the density and expansive force of the gas.—Prof. Leitgeb presented a paper on the growth of *Fissidens*; it conforms to the laws of growth of other mosses.—M. Stefan communicated a memoir on the theory of magnetic forces. The first part treats on calculation of the magnetic force of electric currents; the second, the action of a magnet on an internal point; and the third, the theory of magnetic induction. It is shown, from a series of experiments, that all kinds of iron and steel permit the same maximum of magnetisation, that the resistance of iron and nickel to magnetisation is at first very great, then decreases to a minimum, which is reached when the induced magnetic moment is a third of its maximum, and thereafter the resistance increases to an indefinite extent. From these data a formula is constructed for the magnetic molecular force.

PARIS

Academy of Sciences, May 18.—M. Bertrand in the chair. M. Chasles read a paper entitled "Questions relating to series of similar triangles subjected to three common conditions."—M. Serret presented a note accompanying the presentation of vol. vi. of Lagrange's works. The volume contained eleven memoirs on various astronomical subjects. On the magnetic bundles formed by separate laminæ, by M. Jamin.—M. Faye communicated a letter with a reply by M. E. Gautier, who maintains the old views of Galileo concerning the nature of sun-spots.—New apparatus for the transfusion of blood, proposed by M. Mathieu; a note by M. Bouley.—M. A. Ledieu presented the continuation of his thermodynamical researches entitled "General ideas on the mechanical interpretation of the physical and chemical properties of bodies."—Note on some thermometric observations during winter in the Alps, by Dr. Frankland.—On the influence of ferments on surgical maladies (second note), by M. A. Guérin.—On the combinations of arsenic with molybdic acid, by M. H. Debray.—Note on the employment of iron shot for replacing leaden shot in rinsing bottles, by M. Fordos.—On soluble starch, by M. Musculus. Starch is dissolved in acidulated boiling water, the acid neutralised, and the solution filtered and evaporated to a syruppy consistence. An abundant granular deposit is obtained, which is washed with cold water, and then with alcohol. This soluble starch gives all the reactions of natural starch, and is decomposed by diastase in the same manner, but with greater ease.—On the transmission of the irritation from one point to another in the leaves of *Drosera*, and on the part which the tracheæ appear to play in these plants, by M. M. Ziegler. The author concluded, that the tracheæ, or the fibres surrounding them, transmit the irritation from one hair to another, and that the movements of the hairs of the circumference of the leaves are not reflex movements induced by an irritation proceeding from a centre situated elsewhere than in the leaf.—On the concussion of bodies, by M. G. Darboux.—On the temperature of the sun, a note by M. J. Violle.—Studies on electric chronographs, and researches on the induction spark and on electro magnets, by M. M. Deprez.—On the motion of the air in pipes, by M. C. Bontemps.—M. F. A. Abel communicated his fourth memoir on the properties of explosive bodies.—Note on the decomposition of tungstate and of molybdate of sodium by sal-ammoniac, by M. F. Jean; these substances when boiled with solution of sal-ammoniac disengage ammonia, the liquid remaining acid.—On the constitution of clays, by M. T. Schlœsing.—On the identity of bromoxaform and of pentabrominated acetone, by M. E. Grimaux. The author's experiments show that methylic alcohol and methylic acetate are not attacked in the cold by bromine, but at 150°—170° the latter body is transformed into methylic bromide and bromacetic acids. The substance formed by the action of bromine upon the alkaline citrates is pentabrominated acetone, and the chlorinated bodies obtained by the action of chlorine on citric acid and citrates are chlorinated derivatives of acetone and not of methyl-acetic ether.—Experimental study on the influence of the injection of bile on the organism, by MM. V. Feltz and E. Ritter.—On the hind foot of the *Hyænodon parisiensis*, by M. G. Vasseur.

CONTENTS

PAGE
THE AFRICAN ECLIPSE OF 1874 59
FOOD AND DIETETICS 60
LETTERS TO THE EDITOR:—
  Physical Axioms.—R. B. HAYWARD, A SENIOR WRANGLER . . 61
  Ocean Circulation.—Dr. W. B. CARPENTER, F.R.S. 62
  Glacial Period.—T. BELT, F.G.S 62
  Uncompensated Chronometers.—Prof. J. D. EVERETT 63
  Photographic Irradiation.—W. J. STILLMAN 63
  Hay Fever.—J. RAND CAPRON 63
THE STEAMSHIP *Faraday* AND HER APPLIANCES FOR CABLE-LAYING. Dr. C. W. SIEMENS, F.R.S. 64
ATMOSPHERIC CURRENTS AS OBSERVED IN THE WEST INDIES, AND PARTICULARLY IN ST. THOMAS. By W. G. PALGRAVE 65
THE COMING TRANSIT OF VENUS, VI. (*With Illustration*) By Prof. GEORGE FORBES 66
ATOMS AND MOLECULES SPECTROSCOPICALLY CONSIDERED. By J. NORMAN LOCKYER, F.R.S. (*With Illustrations*) 69
COL. GORDON'S JOURNEY TO GONDOKORO 72
THE EXTINCT FAUNA OF THE MASCARENE ISLANDS 72
NOTES 72
THE FLORENCE INTERNATIONAL BOTANICAL CONGRESS 74
SCIENTIFIC SERIALS 75
SOCIETIES AND ACADEMIES 77

THURSDAY, JUNE 4, 1874

SCIENTIFIC WORTHIES

III.—Charles Robert Darwin

CHARLES ROBERT DARWIN was born at Shrewsbury on Feb. 12, 1809. He is the son of Dr. Robert Waring Darwin, F.R.S., and grandson of Dr. Erasmus Darwin, F.R.S., author of the "Botanic Garden," "Zoonomia," &c.; by the mother's side he is grandson of Josiah Wedgwood, F.R.S., the celebrated manufacturer of pottery. Mr. Darwin was educated at Shrewsbury School under Dr. Butler, afterwards Bishop of Lichfield, and in the winter of 1825 went to Edinburgh University for two years. He there attended to Marine Zoology, and read before the Plinian Society at the close of 1826 two short papers, one on the movement of the ova of Flustra. From Edinburgh Mr. Darwin went to Christ's College, Cambridge, where he took his Bachelor of Arts degree in 1831. In the autumn of 1831, Capt. FitzRoy having offered to give up part of his own cabin to any naturalist who would accompany H.M.S. *Beagle* in her surveying voyage round the world, Mr. Darwin volunteered his services without salary, but on condition that he should have the entire disposal of his collections, all of which he deposited in various public institutions. The *Beagle* sailed from England Dec. 27, 1831, and returned Oct. 22, 1836.

Mr. Darwin married his cousin, Emma Wedgwood, in the beginning of 1839, and has lived since 1842 at Down, Beckenham, Kent, of which county he is a magistrate.

The Royal Society awarded to Mr. Darwin, in 1853, the Royal Medal, and in 1864 the Copley Medal. In 1859 the Geological Society awarded him the Wollaston Medal. He is an honorary member of various foreign scientific Societies, and is a Knight of the Prussian Order of Merit.

Since his return from South America in the *Beagle* Mr. Darwin's life has been comparatively uneventful, even for a scientific man; indeed, so far as the public is concerned, the main events in Mr. Darwin's career have been the publication of his works and papers, which have been far more numerous than many are aware of. We give below a list of them.

General Works

Journal of Researches into the Natural History and Geology of the countries visited by H.M.S. *Beagle*, 1845.

On the Origin of Species by means of Natural Selection, 1859.

This was preceded by a sketch, entitled "On the variation of organic beings in a state of nature;" published in the *Journal of the Linnæan Society*, vol. iii. (Zool.), 1859, p. 46.

The Variation of Plants and Animals under Domestication. 2 vols. 1868.

The Descent of Man, and Selection in relation to Sex. 2 vols. 1871.

The Expression of the Emotions in Man and Animals. 1872.

Zoological Works

The Zoology of the voyage of H.M.S. *Beagle*, edited and superintended by C. Darwin, 1840; consisting of five parts.

A monograph of the Cirripedia, Part 1, Lepadidæ; Ray Soc., 1851, pp. 400.

A monograph of the Cirripedia, Part 2, the Balanidæ; Ray Soc., 1854, pp. 684.

A monograph of the Fossil Lepadidæ; Pal. Soc., 1851, pp. 86

A monograph of the Fossil Balanidæ and Verrucidæ; Pal. Soc., 1854, pp. 44.

Observations on the Structure of the genus Sagitta; Ann. Nat. Hist., vol. xiii., 1844.

Brief descriptions of several terrestrial Phanariæ, and of some marine species; Ann. Nat. Hist., vol xiv., 1844, p. 241.

Botanical Works

On the various contrivances by which British and Foreign Orchids are fertilised, 1862.

On the Movements and Habits of Climbing Plants; Journ. Linn. Soc., vol ix., 1865 (Bot.), p. 1.—This Paper has also been published as a separate work.

On the action of Sea-water on the Germination of Seeds; Journ. Linn. Soc., vol. i., 1857 (Bot.), p. 130.

On the Agency of Bees in the Fertilisation of Papilionaceous Flowers; Ann. Nat. Hist., vol. ii., 1858, p. 459.

On the Two Forms or Dimorphic Condition of the species of Primula; Journ. Linn. Soc., vol. vi., 1862 (Bot.), p. 77.

On the Existence of Two Forms and their reciprocal Sexual Relations in the genus Linum; Journ. Linn. Soc., vol. vii., 1863 (Bot.), p. 69.

On the Sexual Relations of the Three Forms of Lythrum; Journ. Linn. Soc., vol. viii., 1864, p. 169.

On the Character and Hybrid-like nature of the illegitimate Offspring of Dimorphic and Trimorphic Plants; Journ. Linn. Soc., vol. x., 1867 (Bot.), p. 393.

On the Specific Difference between *Primula veris* and *P. vulgaris*, and on the Hybrid Nature of the common Oxslip; Journ. Linn. Soc., vol. x., 1867 (Bot.), p. 437.

Notes on the Fertilisation of Orchids; Ann. Nat. Hist., Sept. 1869.

Geological Works

The Structure and Distribution of Coral-reefs, 1842; pp. 214.

Geological Observations on Volcanic Islands, 1844; pp. 175.

Geological Observations on South America, 1846; pp. 279.

On the Connection of the Volcanic Phenomena in South America, &c.; Trans. Geol. Soc., vol. v.; read March, 1838.

On the Distribution of the Erratic Boulders in South America; Trans. Geol. Soc., vol. vi.; read April, 1841.

On the transportal of Erratic Boulders from a lower to a higher level; Journ. Geol. Soc., 1848, p. 315.

Notes on the Ancient Glaciers of Caernarvonshire; Phil. Mag., vol. xxi., 1842, p. 180.

On the Geology of the Falkland Islands; Journ. Geol. Soc., 1846, pp. 267.

On a Remarkable Bar of Sandstone off Pernambuco; Phil. Mag., Oct. 1841, p. 257.

On the Formation of Mould; Trans. Geol. Soc., vol. v., p. 505; read Nov. 1837.

On the Parallel Roads of Glen Roy; Trans. Phil. Soc., 1839, p. 39.

On the Power of Icebergs to make Grooves on a Submarine Surface; Phil. Mag., Aug. 1855.

An account of the Fine Dust which often falls on vessels in the Atlantic Ocean; Proc. Geol. Soc., 1845, p. 26.

Origin of the Saliferous Deposits of Patagonia; Journ. Geol. Soc., vol. ii., 1838, p. 127.

Part Geology; Admiralty Manual of Scientific Inquiry, 1849. Third ed., 1859.

Two British naturalists, Robert Brown and Charles Darwin, have, more than any others, impressed their influence upon Science in this nineteenth century. Unlike as these men and their works were and are, we may most readily subserve the present purpose in what we are called upon to say of the latter by briefly comparing and contrasting the two.

Robert Brown died sixteen years ago, full of years and scientific honours, and he seems to have finished, several years earlier, all the scientific work that he had undertaken. To the other, Charles Darwin, a fair number of productive years may yet remain, and are earnestly hoped for. Both enjoyed the great advantage of being all their lives long free from any exacting professional duties or cares, and so were able in the main to apply themselves to research without distraction and according to their bent. Both, at the beginning of their career, were attached to expeditions of exploration in the southern hemisphere, where they amassed rich stores of observation and materials, and probably struck out, while in the field, some of the best ideas which they subsequently developed. They worked in different fields and upon different methods; only in a single instance, so far as we know, have they handled the same topic; and in this the more penetrating insight of the younger naturalist into an interesting general problem may be appealed to in justification of a comparison which some will deem presumptuous. Be this as it may, there will probably be little dissent from the opinion that the characteristic trait common to the two is an unrivalled scientific sagacity. In this these two naturalists seem to us, each in his way, pre-eminent. There is a characteristic likeness, too—underlying much difference—in their admirable manner of dealing with facts closely, and at first hand, without the interposition of the formal laws, vague ideal conceptions, or "glittering generalities" which some philosophical naturalists make large use of.

A likeness may also be discerned in the way in which the works or contributions of predecessors and contemporaries are referred to. The brief historical summaries prefixed to many of Mr. Brown's papers are models of judicial conscientiousness. And Mr. Darwin's evident delight at discovering that someone else has "said his good things before him," or has been on the verge of uttering them, seemingly equals that of making the discovery himself. It reminds one of Goethe's insisting that his views in Morphology must have been held before him and must be somewhere on record, so obviously just and natural did they appear to him.

Considering the quiet and retired lives led by both these men, and the prominent place they are likely to occupy in the history of Science, the contrast between them as to contemporary and popular fame is very remarkable. While Mr. Brown was looked up to with the greatest reverence by all the learned botanists, he was scarcely heard of by anyone else; and out of botany he was unknown to Science except as the discoverer of the Brownian motion of minute particles, which discovery was promulgated in a privately printed pamphlet that few have ever seen. Although Mr. Darwin had been for twenty years well and widely known for his "Naturalist's Journal," his works on "Coral Islands," on "Volcanic Islands," and especially for his researches on the Barnacles, it was not till about fifteen years ago that his name became popularly famous. Ever since no scientific name has been so widely spoken. Many others have had hypotheses or systems named after them, but no one else that we know of a department of bibliography. The nature of his latest researches accounts for most of the difference, but not for all. The Origin of Species is a fascinating topic, having interests and connections with every branch of Science, natural and moral. The investigation of recondite affinities is very dry and special; its questions, processes, and results alike—although in part generally presentable in the shape of Morphology—are mainly, like the higher mathematics, unintelligible except to those who make them a subject of serious study. They are especially so when presented in Mr. Brown's manner. Perhaps no naturalist ever recorded the results of his investigations in fewer words and with greater precision than Robert Brown: certainly no one ever took more pains to state nothing beyond the precise point in question. Indeed we have sometimes fancied that he preferred to enwrap rather than to explain his meaning; to put it into such a form that, unless you follow Solomon's injunction and dig for the wisdom as for hid treasure, you may hardly apprehend it until you have found it all out for yourself, when you will have the satisfaction of perceiving that Mr. Brown not only knew all about it, but put it upon record long before. Very different from this is the way in which Mr. Darwin takes his readers into his confidence, freely displays to them the sources of his information, and the working of his mind, and even shares with them all his doubts and misgivings, while in a clear and full exposition he sets forth the reasons which have guided him to his conclusions. These you may hesitate or decline to adopt, but you feel sure that they have been presented with perfect fairness; and if you think of arguments against them you may be confident that they have all been duly considered before.

The sagacity which characterises these two naturalists is seen in their success in finding decisive instances, and their sure insight into the meaning of things. As an instance of the latter on Mr. Darwin's part, and a justification of our venture to compare him with the *facile princeps botanicorum*, we will, in conclusion, allude to the single instance in which they took the same subject in hand. In his papers on the organs and modes of fecundation in Orchideæ and Asclepiadeæ, Mr. Brown refers more than once to C. K. Sprengel's almost forgotten work, shows how the structure of the flowers in these orders largely requires the agency of insects for their fecundation, and is aware that "in Asclepiadeæ . . . the insect so readily passes from one corolla to another that it not unfrequently visits every flower of the umbel." He must also have contemplated the transport of pollen from plant to plant by wind and insects; yet we know from another source that he looked upon Sprengel's ideas as fantastic. Instead of taking the single forward step which now seems so obvious, he even hazarded the conjecture that the insect-forms of some Orchideous flowers are intended to deter rather than to attract insects. And so the explanation of all these and other extraordinary structures, as well as of the arrangement of blossoms in general, and even the very meaning and need of sexual propagation, were left to be supplied by Mr. Darwin. The aphorism "Nature abhors a vacuum" is a characteristic specimen of the Science of the Middle Ages. The aphorism "Nature abhors close fertilisation," and the demonstration of the principle, belong to our age, and to Mr. Darwin. To have originated this, and also the principle of Natural Selection—the truthfulness and importance of which are evident the moment it is apprehended—and to have applied these principles to the system of nature in such a manner as to make, within a dozen years, a deeper impression upon natural history than has been made since Linnæus, is ample title for one man's fame.

There is no need of our giving any account or of estimating the importance of such works as the "Origin of Species by means of Natural Selection," the "Variation of Animals and Plants under Domestication," the "Descent of Man, and Selection in relation to Sex," and the "Expression of the Emotions in Man and Animals,"—a series to which we may hope other volumes may in due time be added. We would rather, if space permitted, attempt an analysis of the less known but not less masterly, subsidiary essays, upon the various arrangements for ensuring cross-fertilisation in flowers, for the climbing of plants and the like. These, as we have heard, may before long be reprinted in a volume, and supplemented by some long-pending but still unfinished investigations upon the action of Dionæa and Drosera—a capital subject for Mr. Darwin's handling.

Apropos to these papers, which furnish excellent illustrations of it, let us recognise Darwin's great service to Natural Science in bringing back to it Teleology; so that, instead of Morphology *versus* Teleology, we shall have Morphology wedded to Teleology. In many, no doubt, Evolutionary Teleology comes in such a questionable shape, as to seem shorn of all its goodness; but they will think better of it in time, when their ideas become adjusted, and they see what an impetus the new doctrines have given to investigation. They are much mistaken who suppose that Darwinism is only of speculative importance and perhaps transient interest. In its working applications it has proved to be a new power, eminently practical and fruitful.

And here, again, we are bound to note a striking contrast to Mr. Brown, greatly as we revere his memory. He did far less work than was justly to be expected from him. Mr. Darwin not only points out the road, but labours upon it indefatigably and unceasingly. A most commendable *noblesse oblige* assures us that he will go on while strength (would we could add health) remains. The vast amount of such work he has already accomplished might overtax the powers of the strongest. That it could have been done at all under constant infirm health is most wonderful.

Asa Gray

THE AUSTRALIAN MUSEUM

THE authorities of the British Museum may congratulate themselves on their not being the only governing body which is considered to be on an antiquated and improvable foundation, which calls for a radical and speedy change. In Australia the same cry has been raised before the Parliament of the Colony, with respect to the Museum at Sydney. There the biological collection seems to be much in need of improvement, of a greater spirit of enterprise in its management, and of a more liberal view being taken by its authorities of the rapid advances which are adding day by day to the importance of the subject which it so materially assists in teaching.

We may reasonably ask, what is given as the cause of this want of energy and progressive spirit in the colonial institution? Curiously enough it is the same as that which is being urged by all scientific men in this country against our national collection, which has found its most powerful expression in the Report of the Royal Commission on Scientific Instruction and Advancement of Science, noticed by us a short time ago (NATURE, vol. ix. p. 397), namely, that it is in the hands of a body of irresponsible trustees with a distributed authority, instead of under the management of a paid superintendent, who alone is accountable for all that is done.

It is the so-called "conservative spirit" of the authorities against which so much evidence of inefficiency is becoming so prominent. Science—and Natural Science especially—has been making such rapid progress of late years, that the mechanism by which it has to be taught, the elaborate nature of which is only fully understood by those who are actual workers within its confines, has not a sufficient inherent "go" to do the work expected of it. Just as by means of manual labour it was possible to thrash the cereal products of this country with profit in former times, whilst in the present day foreign competition makes the much more speedy steam apparatus absolutely essential; so when libraries of ancient manuscripts and the beautiful artistic remains of bygone days were the subjects which formed the most important topics for the consideration of the museum government, the bodies of trustees worked very well. The task they had on hand, being stamped with the name of fine art, was rather a pleasure than a labour; and the members of the board derived a *prestige*, and other advantages, from being able to follow their wonted tastes without any feeling of incompetency, or any scruples as to the general acceptance of their decision.

The biological element in our national collection has, however, introduced a different state of things. Those who can afford, from their pecuniary advantages, to spend their time and energies in unremunerative committees, are not the class who dirty their hands with the preliminary training necessary for a zoological or a botanical education. Neither of these subjects were whipped into them at Eton or at Harrow; they were too old to begin them, except perhaps in a very amateur manner, at Oxford or at Cambridge; and consequently when they find themselves appointed to any authoritative post in after life they set to the work with the antipathy they have always felt against "stinks."

How can a body so constituted be expected to forward the progress of Natural Science? The subject is a modern one. It is in need of hard organising work being done by experienced men who take a true interest in the object to be attained. Such men must be paid, not by paltry salaries no better than that of a banker's clerk; for how can men of ability and education be expected to present themselves as candidates for the posts, when there are so many much more remunerative ways in which they may get a larger competency?

If we look round at our public institutions we find that the machinery of those which prove themselves to be the most successful is that in which a single officer has the control, he being frequently re-elected, and responsible only to a body which criticise all his actions, and to which he refers all serious questions of finance and management. Inefficiency on the part of the officer under this arrangement allows of his replacement without difficulty, at the same time that he is continually kept up to his work by the superior governing body, who find it a much easier task to detect faults than they would to remedy them themselves.

The case of the Australian Museum is somewhat peculiar. That institution seems to be in the hands of a few collectors of the old school, who treat it as a plaything of their own, rather than a public institution, supported by public funds. They have a curator, Mr. Gerrard Krefft, of whose very high scientific position in the mother country they cannot be fully aware, or they would be more liberal to him, and give him more opportunities for the employment of his abilities. The naturalist who on seeing the curious new mud-fish from Queensland was enabled to say from a superficial examination, that it "is allied to Lepidosiren, and is Ceratodus"—a statement which Dr. Günther's superb monograph on that fish so strongly substantiates—and who has done such excellent work with regard to the Marsupialia, both recent and extinct, deserves greater opportunities than he evidently possesses under the tender mercies of amateur trustees, especially when they include among their numbers men such as a Mr. Macleay, who has thought it worth his while to refer to this journal in terms which clearly indicate either that he has never heard of it or of the Royal Commission whose recommendations we reproduced, or that he has not the least sympathy with the subjects of which it treats; the latter of which tendencies must make him quite unsuitable for the position which we regret to see he holds as one of the governing body.

The complaint of Mr. Cooper, who applied for a select committee to inquire into and report upon the condition and system of management of the museum, was that—

> "As a rule a body of trustees was not the proper body to manage such institutions. Persons who were unpaid and irresponsible did not take that interest in the institution they ought to do, and would not devote their time to it. The Government found the whole of the money to pay the cost of the institution, and surely they ought to have a voice in its management. In asking for the committee, he had not the slightest desire to censure the trustees. He believed they did the best they could, but many of them could not devote the time that was necessary."

In the discussion which followed it was shown that on all occasions it is difficult to get a quorum, except on an occasion like that in which it was proposed to employ the museum-building as a ball-room during the visit of the Duke of Edinburgh to Sydney, when of the twenty members of the committee, the ten official were in favour of its employment as such, in opposition to those who sat by election.

A committee was finally appointed to consider the question of appointing a permanent officer, and if they then conclude their deliberations by placing Mr. Krefft in a position worthy of his scientific attainments, they will confer as great a benefit on zoology generally, as they will show a power of appreciating worth, independent of petty party-spirit.

RIBOT'S "ENGLISH PSYCHOLOGY"

English Psychology. Translated from the French of Th. Ribot. (Henry S. King and Co.)

SEEING that the doctrines of the English school of Experimental Psychology are "unknown, or very nearly unknown, in France," M. Ribot has certainly done a very useful work in giving to the French people an analysis of the conclusions in mental science arrived at by Hartley, James Mill, Herbert Spencer, A. Bain, G. H. Lewes, Samuel Bailey, John Stuart Mill. The most substantial objection that could be urged against such an undertaking is the difficulty of doing satisfactorily the thing attempted. In no department of knowledge claiming the name of Science is there so little settled doctrine; indeed, Mr. Lewes has just told us in his "Problems of Life and Mind" that there is still wanting the materials for its construction as a science; nor is there in any science so little agreement among the authorities, or so great probability that honest application may be rewarded with an entire misapprehension of their meaning. The book before us is of course M. Ribot's answer to this objection; and we are bound to say that, considering the special difficulty of the task, and remembering the object he had in view, it is a very worthy and valuable performance. While there is probably not one of the writers whom he has undertaken to expound who would not object to his rendering of one or other of their opinions, all must, we think, agree in regarding M. Ribot as a highly appreciative student, and must feel grateful to him for this attempt to spread their opinions. Indeed to us M. Ribot seems rather to err in the direction of wishing to present in the most favourable light, and to make the most of, the views of each writer in turn.

Partly, perhaps, to this same amiable disposition may be referred the impression of greater agreement among the authorities given by a perusal of M. Ribot's pages than by a study of the authors themselves. Mr. Herbert Spencer is, and with all justice, placed at the head of our psychologists; and Prof. Bain is made to differ from him in no essential particular—an interpretation which we are inclined to believe would be accepted much more willingly by Prof. Bain himself, who now recognises the doctrine of inheritance, and would fain have it understood that his disagreements with Mr. Spencer on some other points "are more apparent than real," than by his less clear-sighted disciples. The account of Prof. Bain's theory of the *supposed* acquisition of voluntary power opens with a statement that here we have "the idea of progress, evolution, and development." But the instructed student in these matters must know that the growth of voluntary power that Prof. Bain would explain is not the evolution of Mr. Spencer; it is, on the contrary, a description of the manner in which, according to his imagination, each individual acquires those powers which, according to the doctrine of evolution, they do not acquire, but inherit. For the benefit of those who would now save this theory by maintaining that it meant or means something that was never intended, we would quote the example given in illustration by M. Ribot:—"Few of our necessities are so pressing as thirst; nevertheless an animal does not distinguish at first that the water in the pond can appease it; it is only later in his wanderings that he comes to apply his tongue to the surface of the water (happy accident) and to feel the relief which it affords, and thus to learn what he ought to will." Few of the poor animals, we fear, would ever reach maturity if they had not more of instinct than Prof. Bain would here allow them. Yet what Prof. Bain has written about instinct he claims, and M. Ribot thinks "justly, as one of the most original portions of his work." Unfortunately for the fame of this celebrated psychologist, it appears from the progress of research that exactly in those departments where he has been most original have his conceptions been least in accordance with the order of Nature.

M. Ribot's most serious labour seems to have been in bringing together, in a more or less connected form, the psychology which has hitherto been scattered through the writings of Mr. George Henry Lewes. This original thinker and highly suggestive writer is the only one of our psychologists whose work may not be regarded as finished. The volume recently published ("Problems of Life and Mind") does not supply material for an estimate of the work on which he has long been engaged. But while continuing to agree with Mr. Spencer much more than any other of the authorities, Mr. Lewes encourages his readers to hope for important and permanent additions to mental philosophy; and to put the prospects of the work at the lowest, he will certainly compel the school to which he belongs to gravely reconsider some of their fundamental positions.

When in his conclusion M. Ribot attempts to bring forward the points on which the writers are agreed, the "fundamental propositions" to which he reduces them are unsatisfactory in two ways. Many of them are so vague in expression as not to exclude rival theories; while others have a sufficient amount of precision to make them flat contradictions of the clearly expressed and reiterated opinions of some of the authorities. We are, for example, not surprised to hear a disciple of Mr. Mill and Prof. Bain express his astonishment that his masters should have fathered on them the realism they have so vigorously opposed. M. Ribot's words are explicit:—"Outside of us, and independently of our perceptions, there exists a material world which condemns idealism. It is conformable to the data of the sciences to believe that this material world, taken in itself, does not resemble the perceptions of it which we have; this condemns vulgar realism." It surely says little for idealism that M. Ribot, after studying and expounding the arguments in its favour, should thus end with making our idealists agree with that very realism which Prof. Bain has described as unworthy the name of Philosophy.

After recognising the shortcomings referred to, it remains to be repeated that the author deserves the thanks of everyone interested in the spread of mental science in France. But we are unable to find any reason for the book having been translated into English. No English student ought to go to M. Ribot for the opinions of Mr. Mill or Mr. Spencer. Should any not already familiar with the topics discussed attempt to read the work, they will frequently be much perplexed by the exceeding carelessness of the translation. If they are amused to read that "*melodies* are described in pathological treatises," they may be a little puzzled to make out how "all Science is *contradicted* by the double action of analysis and synthesis," or in what sense "so long as the living being has no consciousness he leads a purely psychological life." And we would hint to any innocent young persons disposed to pin their faith to Locke, that they may be in some danger of being misunderstood should they follow the uniform usage of the translator and describe themselves as "*sensualists*." DOUGLAS A. SPALDING

OUR BOOK SHELF

Africa: Geographical Exploration and Christian Enterprise. By A. Gruar Forbes. (London: Sampson Low and Co. 1874.)

WE can recommend this moderate-sized volume as an interesting popular *résumé* of the progress of discovery in Africa from the earliest time to the present day. The author writes mainly from the point of view of missionary enterprise, but seems to have read with diligence and intelligence the greater part of the literature of modern African travel, with which his book is mostly concerned, and has made therefrom a creditable compilation showing the progress of discovery from Bruce downwards. The first chapter gives a brief account of the topography, climate, and productions of Africa; and the accompanying pretty clear map shows the route of the leading explorers. We notice one or two signs of carelessness or haste; for example, on p. 4, Mr. Forbes states that "the most westerly point is Cabo Verde, in long. 51° 25′ E., lat. 10° 25′ N., the distance between the two points being about the same as it's length." Again, at p. 115, "Sahara Desert" ought surely to be "Kalahari Desert."

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Ocean Circulation—Dr. Carpenter and Mr. Croll

IN the interests of Science, of scientific discussions, and of scientific men let me be allowed to protest very earnestly against the manner in which Dr. Carpenter has thought fit to reply in your columns to the defence which Mr. Croll made against the representation of his views, given in NATURE, vol. ix. p. 423. I take much interest in the subject under discussion—the great fundamental cause of the distribution of heat over the globe, and am most anxious to arrive at the true solution of the problem—a result, however, which will be indefinitely postponed if such letters as that of Dr. Carpenter in NATURE, vol. x. p. 62, are to become common.

Mr. Croll, discarding unimportant details, asked attention to one or two cardinal "misapprehensions" on which Dr. Carpenter had been proceeding. But the Doctor, instead of plainly grappling with these alleged "misapprehensions," runs off to call attention to a footnote of another paper of Mr. Croll's, brings forward some statement of Mr. Croll's views about the relative saltness of different portions of the ocean (about which, however, not a single word is said in the letter that has called forth Dr. Carpenter's reply), and concludes by another *argumentum ad hominem*, of which I am sure every reader of his papers must now be weary.

Now I strongly object to have dust thrown in my eyes in this way. Dr. Carpenter does not attempt to deal with any one of the cardinal and crucial arguments in Mr. Croll's letter. He raises a cloud about "averages," repeats his joke about ten children to every marriage, and with other irrelevant matter, including an introduction of the Astronomer Royal and Prof. Mohn, suddenly disappears. Not, however, without adding a sentence which I am sure he will in the end regret. He says he has "been forced by the personal attacks in which Mr. Croll has latterly thought fit thus to indulge to retort upon him." Why, the discovery of anything "personal" in Mr. Croll's writings would be as great a find as the true theory of oceanic circulation. I do not know any papers in our contemporary scientific literature more thoroughly undeserving of such a charge. Surely a man may call in question, nay, may even take a little quiet fun out of another man's opinions or crotchets without laying himself open to the stigma of being guilty of "personal attacks." Besides, it seems to me that Dr. Carpenter's charge is inappropriate. Mr. Croll, remarking "with some reluctance" that he was "compelled to refer" to Dr. Carpenter's continual quotation of eminent physicists who had adopted his views, while none had shared in the objections to them, merely assured Dr. Carpenter that such was not the case, and made reference to one person as an illustration, but without giving the person's name. The Doctor, as everybody knows, has been profuse in his use of this kind of argument. And now the moment it is used against himself, he denounces the introduction of "personal attacks!"

I purposely avoid entering into the merits of the question. What, in common with every sincere well-wisher of Science, I desire to see, is its thorough, honest and courteous discussion. Dr. Carpenter's high position gives a weight to what he says and does, which adds much to the regret with which his letter will be perused. That this protest may be received on its own merits and without reference to the pen which holds it, I withhold my name.

F. R. S.

Proportionality of Cause and Effect

MR. HAYWARD now affects the air of an injured man, and complains of being charged with "confusing issues" which he neither "raised nor accepted." He may be convicted out of his own mouth. The following passage occurs in his last letter but one (NATURE, vol. x. p. 25):—"It should be noted that my principal 'exemplification of *unconsciously-formed preconceptions*' was of Mr. Spencer's own choosing, namely, Newton's 'Second Law of Motion.'" In his last he says:—"The object of my remarks was simply to test the truth of a definite assertion of Mr. Spencer that 'the Second Law of Motion is an immediate *corollary of the preconception* of the exact quantitative relation between cause and effect.'"

Now let the words italicised be compared. In the first passage Mr. Spencer is said to hold that the Second Law of Motion is a preconception. In the second he is represented as maintaining that it is a *corollary* from a preconception. Is not this "confusing issues"?

Mr. Hayward has the choice of two alternatives. He may admit that one of these statements is a misrepresentation of Mr. Spencer's doctrine, as was alleged. Does he refuse to do this? Then he may transfix himself on the other horn of the dilemma, and boldly assert that in his view a preconception and a corollary from a preconception are one and the same thing. But until Mr. Hayward can arrive at some agreement with himself as to the terms in which he shall state Mr. Spencer's theory, the conclusion of impartial outsiders will probably be that he is not yet in a position to pronounce authoritatively on the merits of it.

"A Senior Wrangler" is good enough to say that my letter makes him feel "something like Alice behind the looking-glass." After this amenity, one may be pardoned for stating the position which *his* mental altitude leaves. A famous metaphysician once wrote an essay to prove that the narrow discipline of mathematics produces an incapacity for general reasoning. Sir W. Hamilton would have found his *à priori* arguments confirmed if he could have read the letter of "A Senior Wrangler."

The "Senior Wrangler" quotes a sentence of mine to the effect that "the experiences these propositions record all implicate the same consciousness—the notion of proportionality between force applied and result produced; and it is out of this latent consciousness that the axiom of the perfect quantitative equivalence of the relations between cause and effect is evolved." He does not quote a previous passage in which it is said:—

"Here, as in the examples about to be given, the relation between cause and effect, though numerically indefinite, is definite in the respect that every additional increment of cause produces an additional increment of effect; and it is out of this and similar experiences that the idea of the relation of proportionality grows and becomes organic."

It might have been supposed that the doctrine so expressed was effectually guarded against misapprehension. Are not the preconceptions derived from the child's muscular experiences described as *numerically indefinite* (*i.e.* not expressible in *proportional numbers*)? Is it not said that out of them the idea of the relation of proportionality *grows*?" In the very sentence quoted by the "Senior Wrangler," is it not said that the notion of proportionality is *implicated* in the child's consciousness, and that the physical axiom comes from this *latent* consciousness? And yet the "Senior Wrangler," looking down from his mathematical heights, and catechising me as he would a schoolboy, asks me whether I know "what proportionality means"?

But for the letter of a "Senior Wrangler," one would have believed that it was made clear to everyone that the notion of proportionality generated by these early experiences was vague and general, not exact. How else should I have said that from it "the axiom of the perfect quantitative equivalence of the relations between cause and effect is *evolved*?" After thrice reading "First Principles" does not the "Senior Wrangler" know that being evolved includes passing from indefiniteness to definiteness? How then can he pretend that it is meant that the child gets from his experiences the knowledge that a double effort produces in all cases just double the result? The argument obviously implied is that this is the *finished conception* finally arrived at by the adult, as holding in those cases where causes and effects are uncomplicated.

Having but limited space, and assuming that the requisite qualifications would be made by unbiased readers, I passed over all those details of the child's experiences which would have been required in a full exposition Of course I was aware that in the bending of a stick the visible effect does not increase in the same ratio as the force applied; and hardly needed the "Senior Wrangler" to tell me that the resistance to a body moving through a fluid increases in a higher ratio than the velocity. It was taken for granted that he, and those who think with him, would see that out of all these experiences, in some of which the causes and effects are simple, and in others of which they are complex, there grows the consciousness that the proportionality is the more distinct the simpler the antecedents and consequents. This is part of the preconception which the physicist brings with him and acts upon. Perhaps it is within the "Senior Wrangler's" knowledge of physical exploration, that when the physicist finds a result not bearing that ratio to its assigned cause which the two were ascertained in other cases to have, he immediately assumes the presence of some perturbing cause or causes, which modify the ratio. There is, in fact, no physical determination made by any experimenter which does not assume, as an *à priori* necessity, that there cannot be a deviation from proportion without the presence of such additional cause.

Returning to the general issue, perhaps the "Senior Wrangler" will pay some respect to the judgment of one who was a Senior Wrangler too, and a great deal more—who was distinguished not only as a mathematician but as an astronomer, a physicist, and also as an inquirer into the methods of Science: I mean Sir John Herschel. In his "Discourse on the Study of Natural Philosophy," he says:—

"When we would lay down general rules for finding and facilitating our search, among a great mass of assembled facts, for their common cause, we must have regard to the characters of that relation which we intend by cause and effect."

Of these "characters" he sets down the third and fourth in the following terms:—

"Increase or diminution of the effect, with the increased or diminished intensity of the cause, in cases which admit of increase and diminution."

"Proportionality of the effect to its cause in all cases of *direct unimpeded* action."

Observe that, in Sir J. Herschel's view, these are "characters" of the relation of cause and effect to be accepted as "general rules for *guiding* and facilitating our search" among physical phenomena—truths that must be taken for granted *before* the search, not truths derived *from* the search. Clearly, the "proportionality of the effect to its cause in all cases of direct and unimpeded action" is here taken as *à priori*. Sir J. Herschel would, therefore, have asserted, with Mr. Spencer, that the Second Law of Motion is *à priori*; since this is one of the cases of the "proportionality of the effect to its cause."

And now let the "Senior Wrangler" do what Sir J. Herschel has not done or thought of doing—*prove* the proportionality of cause and effect. Neither he, nor any other of Mr. Spencer's opponents, has made the smallest attempt to deal with this main issue. Mr. Spencer alleges that this cognition of proportionality is *à priori*: not in the old sense, but in the sense that it grows out of experiences that precede reasoning. His opponents, following Prof. Tait in the assertion that Physics is a purely experimental science, containing, therefore, no *à priori* truths, affirm that this cognition is *à posteriori*—a product of conscious induction. Let us hear what are the experiments. It is required to establish the truth that there is proportionality between causes and effects, *by a process which nowhere assumes* that if one unit of force produces a certain unit of effect, two units of such force will produce two units of such effect. Until the "Senior Wrangler" has done thus he has left Mr. Spencer's position untouched.

Bayswater, May 20 JAMES COLLIER

The Great Ice-Age

IN reply to Mr. Belt's letter (p. 62), I did little more than express an adverse opinion to his theory, because to discuss it would have required an essay. I expressed this because I notice that unless something like a demurrer is entered against a new theory it is apt to be taken for granted in subsequent textbooks and papers written by those who have had no opportunities of obtaining a practical knowledge of the subject. For the above reason I must answer his strictures very briefly.

(1) I fail to see why the Scandinavian sea-beaches are irrelevant. (2) I have more than once read Mr. Tiddeman's paper, and without committing myself to all its conclusions, think I may quote it as assuming that the Lake district (as distinguished from North Lancashire) was the centre of a great ice-sheet; not that it was over-ridden by ice coming from somewhere further north. The same might be expected to be the case with the Welsh mountains; and Mr. W. Kingsley has brought forward good evidence of the existence of an ice-sheet there also. (3) Mr. Belt appears to forget that shells have been found not only at Moel Tryfaen, but also near Llyn Ffynnon-y-gwas, about two miles west of the peaks of Snowdon. Does Mr. Belt mean to say that Snowdon could not protect itself in the heart of its own domain better than this? If the Lake mountains had an ice-sheet, surely Snowdonia? Mr. Belt asks for evidence of the shore of the glacial sea. I reply that to me these and the Moel Tryfaen beds, not to mention others, appear to be far more probably littoral deposits than transported. For example, I think it in the highest degree improbable that the Vale Royal shells (Lyell, "Antiquity of Man," p 317) could be brought to their present position (more than 1,100 feet above the sea) by any ice-sheet without the cold being enough to cover *all* the higher ground in Britain with ice, and so protect it. I did not deny a glacier might push a stone before it up-hill; my contention was that the enormous force which would be exerted on beds scooped out as described, and shoved some 1,500 feet up-hill for miles over broken ground, would crush the shells to a far more comminuted state than they are now in. With regard to Holderness, Mr. Croll's view of the shells there appears to me to be at present only a *theory* of which Mr. Searles V. Wood, jun., has effectually disposed (Geol. Mag. 1872). I grant there are some difficulties in the submergence theory; my position is that those in Mr. Belt's are very much greater.

A recent perusal of Mr. J. Geikie's suggestive book, the "Great Ice Age," has brought before my mind more strongly than ever a dilemma, which, as it appears to me, the modern school of Glacialists cannot escape.

He speaks of the till as a *grund moräne* or *moraine profonde* formed between the glacier and the rock, while he attributes the majority of rock-basins to the action of the glaciers. Now it appears to me that if the glaciers could pass over considerable deposits of this *moraine profonde* without sweeping it clean away, then their action as erosive agents must have been comparatively feeble; or, if they could scoop out great rock basins like the Alpine and (buried) Highland lakes, then they would have peeled off almost all the till from the land. As it appears to me, the analogy with a river, by means of which Mr. J. Geikie (p. 88) seeks to escape from a portion of this difficulty, does not hold. When a river begins to deposit sand and gravel largely, its work as an erosive agent at that place is almost over. Besides we cannot conceive a nearly solid mass, like a huge glacier, changing its motion so rapidly as a stream of water. Difficult as it undoubtedly is to explain some of the lake-basins, it appears to me that the great bulk of his evidence, with regard to till and other deposits over which ice-streams have passed, shows how slight under ordinary circumstances is their erosive power; and this has been confirmed by every journey that I have made among the Alps. I may add also that from study of the same regions my faith in a *moraine profonde* is much shaken. I believe that, except possibly as a very local and exceptional phenomenon, it exists solely in the imagination of the eminent geologists of whom Mr. Geikie is a disciple. T. G. BONNEY

St. John's College, Cambridge, May 26

Photographic Irradiation

IN the paper referred to by Prof Forbes (NATURE, vol. x. p. 29) what is ordinarily called Photographic Irradiation was attempted to be explained by us, not as being caused by reflections from the back of the plate, but as being due to the sum of all the optical imperfections of the instrument with which the photograph is taken.

If Mr. Stillman (p. 63) will refer to our original paper, published in the *Monthly Notices* for June 1872, he will find that only the cloudy indefinite haze which surrounds the image of a luminous object, and which has frequently been called halation, was referred by us to reflection from the back of the plate.

When an over-exposed photograph is taken upon an opaque plate a marked fringe of irradiation still remains, and experiments were instituted by us which appeared to show that this is not to be accounted for by any circulation taking place within the thickness of the collodion or by the chromatic dispersion of the lenses; but when the oblique pencils from the edges of the lenses were stopped out the irradiation fringe was found to be greatly decreased. We were led to conclude that irradiation is to be accounted for by the fact that each luminous point in the object is not accurately represented by a luminous point in the image, but rather by a luminous patch of sensible area, the central and more intense portion of which prints itself first in the photograph, giving comparatively sharp picture prints when the exposure is short; but as the picture is still further exposed, the outer portions of the luminous patches imprint themselves, and by their overlapping cause the blurred appearance to which has been given the name of irradiation. LINDSAY

A. COWPER RANYARD

Uncompensated Chronometers and Photographic Irradiation

WITH regard to the employment of uncompensated chronometers (NATURE, vol. x. p. 63), I have every reason to believe that the Russians alone have tested them. For some reason which is not easily discovered, the employment of a negatively compensated chronometer has not given any very remarkable results. The Russians have employed simply an uncompensated chronometer; and have obtained very remarkable results as mentioned in my article on the Transit of Venus to which Prof. Everett has alluded.

With regard to the prevention of photographic irradiation, of course various means have been employed for dry plates; but I believe that Lord Lindsay and Mr. Ranyard were the first to experiment on the matter exhaustively. I believe Mr. Stillman would be interested in reading their paper in the *Monthly Notices*. At the same time all honour is due to the photographers named by him for their experiments.

Birkenhead, June 1 GEORGE FORBES

The Seal Fishery

CAPT. DAVID GRAY, of the steamship *Eclipse*, has done good service to the cause of humanity in writing, and Mr. Buckland in publishing, the letter on the seal fishery which appears in *Land and Water* for May 9. The fearful cruelties perpetrated year after year, and the enormous waste of life entailed by the reckless manner in which the seal fishery is prosecuted, are well known, but no steps have hitherto been taken to regulate a trade which, if carried on within proper bounds, would continue to yield great profits, but if still pursued with such utter disregard to consequences must soon end in the extermination of the whole race. As an instance of the wastefulness of the mode of proceeding, Capt. Gray says that five ships attacking a pack of seals, in four days killed about 10,000 old seals; "add 20 per cent for seals mortally wounded and lost, gives an aggregate of 12,000 old ones; add 12,000 young which died of starvation, gives 24,000; but this is not all. The men spread on the ice, so that the old ones that were left alive could not get on to suckle their young. The consequence was that the whole of the young brood was destroyed, and had these seals been left alone for *eight or ten days*, I am quite within the mark when I say that, instead of only taking 300 tons of oil out of them, 1,500 could as easily have been got, and that without touching an old one." In one day by the men of the five ships upwards of 4,000 old seals were taken, "the young ones in thousands yelling for their mothers, following the skins as the men dragged them to the ships, and sucking the crangs, *i.e.* skins, in desperation." The maternal love for its offspring was made use of to save the men trouble, as a seal killed when giving suck was more easily secured, and often seals desperately wounded were seen administering nourishment to their young ones. The plight of the young ones which had lost their mothers was pitiful in the extreme; they were seen huddling together for heat, "and trying to suck one another," till they at length succumbed. Capt. Gray exclaims, "surely there is influence enough left in Great Britain to prevent a continuation of such barbarity. I overheard some of my men saying to one another, 'It is a shame this sort of work;' and so it is. It is a shame that any civilised Government should allow its subjects to perpetrate such cruelty when it could so easily be prevented. The remedy is simply, *let the ships be kept from sailing before March* 25; ships now sail from Feb. 25 to March 1. This would give a fortnight to make the passage, and find the seals in; by that time the young would be beginning to be worth taking, and a fearful waste of life put a stop to that now annually occurs." The accounts of the cruelties practiced in sealing are sickening in the extreme, the only thing considered being how to deprive as great a number of their skin and blubber in as short a time as possible. Mr. Brown (Proc. Zool. Soc., 1868) remarks: "Seals are very tenacious of life, and difficult to kill, unless by a bullet through the brain or heart. They are so quickly *flensed* (the operation of removing the blubber and skin) that after having been deprived of their skin they have been seen to strike out in the water; so that the sympathies of the rough hunters have been so excited that they will pierce the heart several times with their knives before throwing away the carcass." These movements Mr. Brown attributes to reflex action, but considering the haste of the operation, and the seal's known tenacity of life, it is quite as likely that it was merely a stunned and not a dead animal thus deprived of its skin and blubber. It is terrible to dwell thus upon the horrors of this cruel trade, which make even the hardened participators sicken and relent, but it is necessary that it should be done, in order, if possible, to reach the hearts of Englishmen, and enlist their sympathies. If these beautiful and harmless creatures must be sacrificed for our requirements, it is a duty incumbent upon us to see that their destruction is carried out mercifully, and with the infliction of as little suffering and waste of life as possible.

In a commercial point of view the reasons for exercising some supervision over the seal fishery are as strong as those dictated by mere humanity. The revenue produced by this branch of industry is considerable. Mr. Brown estimates the annual value of the Greenland fishery alone at 116,000*l.* (Proc. Zool. Soc., 1868, p. 439), and ominously adds: "Supposing the sealing prosecuted with the same vigour as at present, I have little hesitation in stating my opinion that, before thirty years shall have passed away, the 'seal fishery' as a source of commercial revenue will have come to a close, and the progeny of the immense number of seals now swimming about in the Greenland waters, will number comparatively few." We cannot plead want of warning, for we have numerous instances of marine animals which have been exterminated by untimely slaughter (See Prof. Newton's "Extermination of Marine Mammalia," NATURE, vol. ix. p. 112). Steller's Mantee survived its discovery only about twenty-seven years; the Atlantic Right Whale, which formerly gave employment to a great number of hardy fishermen in the Bay of Biscay and English Channel, is probably exterminated; the Northern Right Whales are gradually driven farther and farther north, and the risk of following them is becoming proportionately greater; the same may be said of the walrus. The northern fur-seal was rapidly passing away, and but for the timely intervention of the Russian and American Governments would probably have been lost; and from our antipodes comes an appeal repeating all the cruelties and waste of life to which our northern seals are subjected, and pleading for protection on behalf of the southern fur-seals (W. A. Scott, "Mammalia, Recent and Extinct," Sydney, 1873).

The question arises, how is this wanton destruction to be stopped and the fishery to be placed on a sounder footing? In order that it may be done effectually, the regulations must, without doubt, be "international;" and no time should be lost in carrying them into effect. The British Association has rendered good service in obtaining an Act to protect sea-birds during their breeding-time, and if, assisted by men of practical experience such as Capt. Gray, they were to urge upon the Government some course of action, they would be supported by all the scientific bodies and leading naturalists in the kingdom.

Norwich, May 12. THOS. SOUTHWELL

THE COMING TRANSIT OF VENUS *

VII.

IN our last article the preparations of Britain, Germany and Russia were enumerated; those of the French, Americans, Dutch, and Italians must now be spoken of.

V. The French will occupy the following stations:—Yokohama, Pekin, New Amsterdam or St. Paul's, and Campbell Island; all equipped as first-class stations, besides Tientsin, Sagou, Numea, and probably Nukahiva in the Marquesas, as secondary stations. Yokohama and St. Paul's will make an excellent combination for the method of durations; at Campbell Island also the durations will be considerably lessened. But the longitude of these places will be determined, so that if only one contact be observed, De l'Isle's method will be applied. MM. Wolf and André have made a series of experiments on the formation of the "black drop;" numerous trials have also been made with a view of employing the photographic method as successfully as possible, and it is possible that spectroscopic observations of external contact will be made. The preparations are by no means so far advanced as might have been wished. This is partly due to the disturbed state in which the country has been since the late war.

We are glad to be able to state that the French will employ the daguerreotype process of photography. This method has many advantages, and it is much to be regretted that no experiments have been made by other nations to test its applicability. Photographs taken by this process are well known to be much more delicate and give clearer details than any others, while photographic irradiation is reduced to a minimum. It is even possible to correct for curvature of field by employing prepared plates whose surfaces are portions of spheres, a thing which would be impossible by any other process. There can be no shrinking of the film. The only objection is, that we cannot print copies from the plates conveniently. But it is not likely that we should trust to measurements of a printed copy even from a glass negative. The French are relying mainly upon the photographic method, and have chosen their stations for determining thus directly the least distance between the centre of the sun and Venus. With the apparatus proposed by MM. Wolf and Martin, the size of the sun's image will be 60 millimetres; they hope to determine the instants of internal contact with a probable error of one second of time. The commission into whose hands the business has been entrusted has drawn up a detailed report containing contributions not only from the astronomers of France, but also from the most celebrated physicists and experimentalists: 300,000 fr. has been voted for the enterprise. M. Tisserand of the Toulouse Observatory will aid in the actual observations; and M. Jannsen will proceed to Yokohama.

M. Dumas takes the lead in the preparations. In a letter dated May 12, he says that the expeditions are on the point of starting, and that the Marquesas probably, and Numea certainly, will be occupied for De l'Isle's method.

VI.—The Americans have a grant of 150,000 dols. They have paid great attention to the application of photography with the assistance of Mr. Rutherford, whose success in photographing the moon is so well known,

---

* Continued from p. 69.

They employ a lens of 40 ft. focus, as already described. They will measure both angles of position and distances from the centre, and the probable error of any measurement will be less than 1-100 per cent. They have encountered some trouble in the manufacture of their siderostats. Besides photography eye-observations of contact will also be made. A very able report has been drawn up from the computations of Mr. Hill, who deserves great credit for the manner in which he has completed it. This report has reference to the choice of stations; and is accompanied by very valuable charts. Other reports have been made upon the application of photography.

The expeditions are to be composed of five persons each. The stations of observation and the heads of parties are as follows:—Wladivostock, Siberia, Prof. A. Hall, U.S.N.; Nagasaki, Japan, Mr. G. Davidson, U.S. Coast Survey; Peking, China, Prof. James C. Watson; Crozet's Island, South Indian Ocean, Capt. Raymond, U.S A.; Kerguelen's Island, South Indian Ocean, Lieut.-Commander George P. Ryan, U.S.N.; Hobart Town, Tasmania, Prof. W. N. Harkness, U.S.N.; New Zealand, Prof. C. H. Peters; and Chatham Island, South Pacific, Mr. Edwin Smith, U.S. Coast Survey.

The whole organisation has been entrusted to a commission, the secretary of which is Prof. Newcomb, who has done so much valuable work for astronomy; he has taken great pains to insure success for the expedition, and has visited Europe to discuss the preparations necessary and to examine the instruments to be employed.

VII.—The Italians have arranged to send out three expeditions furnished with spectroscopes for the observation of external contact. Little is known about these expeditions.

VIII.—The Dutch are sending one expedition to the island of Bourbon or Réunion. It will be furnished with a photo-heliograph, which Dr. Kaiser will manipulate; Dr. Oudemans will also make observations with a heliometer.

Having now completed our description of the details, and having also given an account, so far as possible, of the preparations of the various nations for the observations, we shall cast a general view over the whole subject, and recapitulate some of the principal details.

The coming transit of Venus will be observed from about 75 stations, at many of which there will be a large number of instruments. The expense of the whole of the expeditions will amount to between 150,000*l*. and 200,000*l*. It may seem to some that the results to be arrived at are not worth so great an outlay, but the general voice of the non-scientific as well as of the scientific world has contradicted this. Wherever knowledge can be gained it is worth being gained; and when individuals are unable to bear the cost, it is fitting that the expenses should be incurred by those governments that are really the gainers from many scientific researches for which the investigator himself frequently receives no reward. But apart from this, these expeditions will lead to most valuable results. The sun's distance being known, the Lunar Theory may be vastly improved, and it will be possible to determine longitudes with much greater accuracy than at present. Still more will the tables of Venus be capable of re-adjustment. Even now we can calculate her place with great accuracy, and this is fortunate, since it enables us to predict the exact time at which Venus will first come in contact with the sun, viz. 1874, Dec. 8d. 14h. 4m. The error to which this is liable, owing to the tables, is not likely to exceed five minutes. Mr. W. H. M. Christie, chief assistant of the Royal Observatory, has determined the probable error in the calculated time of contact arising from this cause.* He has employed observations of Venus taken at this node at the following dates:—1872, June 28; 1873, Jan. 18; 1873, Sept. 14; he has thence deduced the error in the tabular position of Venus, and from this the error in the time of contact in the coming transit. It appears from each of these three comparisons that the tables of Venus give us the time of contact too early; according as we adopt the first, second, or third of the above observations, the error will be 7·4m., 5·3m., or 4·2m.

Besides the astronomical advantages to be gained from the coming transit, there are several collateral issues of no small importance. In the first place, the longitudes of a host of stations all over the globe will be accurately determined, and it is a remark by no means unworthy of notice that the simple observation of the local time of contact will give the inhabitants of east Africa and of all Asia an accurate means of determining their absolute longitudes. If, moreover, as has been proposed, San Francisco and Japan are to be compared directly as to longitude, the whole circuit of the globe will be completed by telegraphic and accurate chronometric determinations.

Again, with the host of vessels by which scientific men will proceed to their stations, meteorological, and sometimes even magnetical, instruments will be provided. These vessels will be traversing the different oceans of the globe about the same time, and thus the meteorology of the world will be much better understood. Many observers will be enabled to take note of interesting phenomena, such as hurricanes, volcanoes, and earthquakes. In addition, naturalists will be appointed to accompany some of the expeditions; birds and marine animals will be probably very generally collected; the Royal Society has given funds to aid in this matter. The Rev. A. E. Eaton, who has made valuable collections at Spitzbergen, will examine the marine life of Kerguelen's Island. Rodriguez is particularly interesting from a naturalist's point of view; it is one of the few islands in mid-ocean which have not been raised by volcanic agency. The remains of some extinct birds have been found there. The Royal Society has appointed a geologist, a botanist, and a naturalist to go to this island. There is little doubt that Science in general will gain greatly by these expeditions.

As to the main observation we can have no doubt from the large number of expeditions, and from the multiplicity of methods to be employed, that we shall obtain excellent results, although the actual reduction of the observations will be exceedingly laborious. Each nation, while it generally adopts some special method for its choice of stations, will also utilise other methods. We have seen that the English, while they rely chiefly on De l'Isle's method, will employ all the others except the heliometric, while the Germans depend mainly upon the heliometric method. The French and Americans have chosen their stations with reference to photography. The Russians are to compare observations of all kinds with different nations. These countries have all co-operated in the most harmonious manner, partly by correspondence, and partly by the personal visits of astronomers to different nations.

Although the observations are to be made at the end of the present year, the actual reduction of the observations will take so long that we cannot hope for the complete and final results as to our distance from the sun before the year 1876. At each of the British stations the observers will remain at least three months to determine their longitudes.

Here we may leave the subject. The preparations are for the most part completed; many of the observers of different nations are on their way to their various posts. It says a great deal for the civilisation of the world that on December 8 of the present year those quarters of the globe will be thickly studded with emissaries from so many nations to observe an important astronomical phenomenon.

It will be well to conclude this series of articles with a statement of the arrangements which have been made as to observers on the British expeditions. It is extracted from instructions published under authority:—

---

* Monthly Notices of the R. A. S. xxxiv. 300.

Appointments of Observers to the several Districts of Observation, and Subordination of Observers

1. Capt. G. L. Tupman, R.M.A., is head of the entire enterprise, and is responsible through the Astronomer Royal to the Government for every part. Every observer is responsible to Capt. Tupman.

2. When the different expeditions are separated, the observers in each district of observation are responsible to the local chief of the district, and the chief to the Astronomer Royal. The districts of observation and the observers will be the following, the name first following that of the local chief being that of the deputy, who will, if necessary, take his place:—

3. District A. Egypt: Chief, Capt. C. O. Browne, R.A., astronomer; Observers, Capt. W. de W. Abney, R.E., astronomer and photographer; S. Hunter, astronomer.

4. District B. Sandwich Islands: General Chief, Capt. G. L. Tupman, R.M.A.; Deputy, if necessary, Prof. G. Forbes.

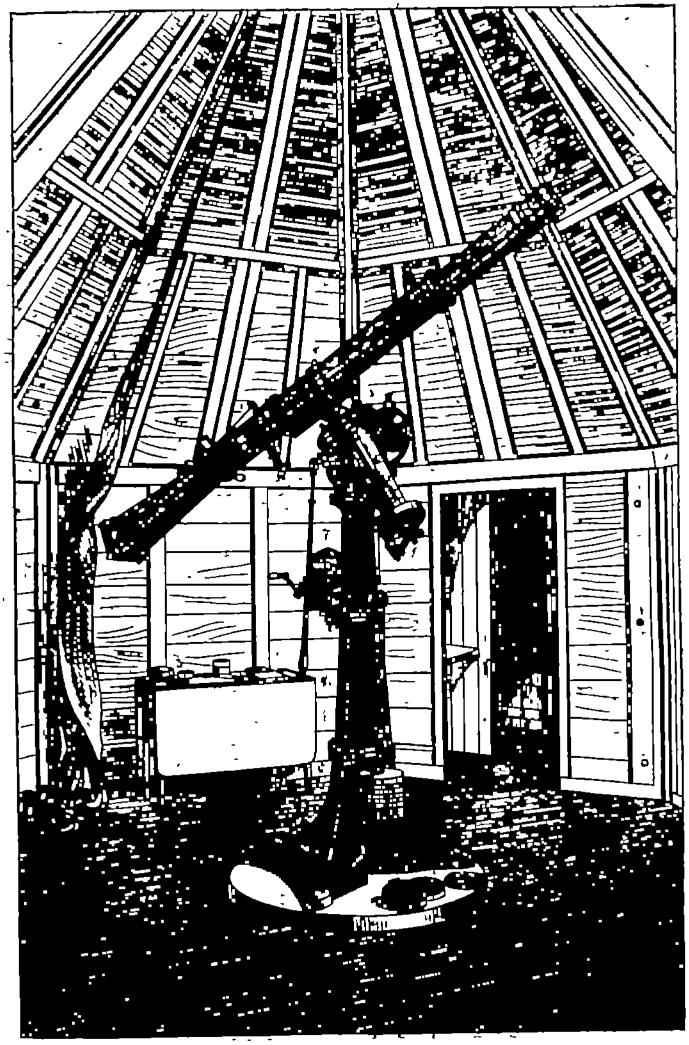


FIG. 19.—Photo-heliograph of the British Expeditions

Sub-divisions of the Sandwich Islands:—Honolulu: Chief, Capt. G. L. Tupman, astronomer; Observers, J. W. Nichol, astronomer and photographer; Lieut. F. E. Ramsden, R.N., astronomer and photographer. Hawaii: Chief, Prof. G. Forbes, astronomer; Observer, H. G. Barnacle, astronomer. Kauai: Chief, R. Johnson, astronomer; Observer, Lieut. E. J. W. Noble, R.M.A., astronomer.

5. District C. Rodriguez: Chief, Lieut. C. B. Neate, R.N., astronomer; Observers, C. E. Burton, astronomer and photographer; Lieut. R. Hoggan, R.N., astronomer and photographer.

6. District D. Christchurch (New Zealand): Chief, Major H. Palmer, R.E.; Observers, Lieut. L. Darwin, R.E., astronomer and photographer; Lieut. H. Crawford, R.N., astronomer.

7. District E. Kerguelen Island: General Chief, Rev. S. J. Perry; Deputy, if necessary, Lieut. C. Corbet, R.N.

Sub-divisions of the Kerguelen Island:—Christmas Harbour: Chief, Rev. S. J. Perry, astronomer and photographer; Observers, Revs. W. Sidgreaves, astronomer; Lieut. S. Goodridge, R.N., astronomer; J. B. Smith, astronomer and photographer. Port Palliser: Chief, Lieut. C. Corbet, R.N.; Observer, Lieut. G. E. Coke, R.N.

8. In addition to these gentlemen, three non-commissioned officers or privates of the corps of Royal Engineers will be attached to each of the five districts, and will be under the direction of the chief of each district.

GEORGE FORBES

ATOMS AND MOLECULES SPECTROSCOPICALLY CONSIDERED *

II.

I now pass on to another part of my subject.

7. *When low temperatures are employed it is generally acknowledged that there is an important difference in kind between the spectra of metals and those of metalloids, taken as a whole.*†

Spectroscopically it is more easy to define the difference between these two great classes of metals than the chemists among you would imagine. I will ask you to take the spectrum of the third class of stars as being as good a representation of the spectrum of a metalloid as anything I can place before you. It is rhythmic, the other two are not. It is a "channelled space" spectrum.* That defines a metalloid spectrum; and a similar spectrum in the case of hydrogen is referred by Angstrom, Stewart, Schuster, and others to an impurity. I have before referred to temperature and told you that the temperature of a Bunsen burner is enough to set an atom of sodium free from its combination with chlorine and make its vapour give us a bright line. I have told you we cannot do this in the case of iron and other substances. We may say then that we have there a first stage of temperature. Many monad metals give us their line spectra at a low degree of heat. Take some dyad metals such as zinc and cadmium; this first stage of temperature will only make them red or white hot, a much higher temperature is required to drive them into vapour. We get the line spectrum from sodium; do we get that from cadmium when we have melted cadmium? We do not. That is an excessively important point. The first stage of temperature, which gives you a line spectrum in the case of sodium, is powerless to give you such a spectrum in the case of cadmium.

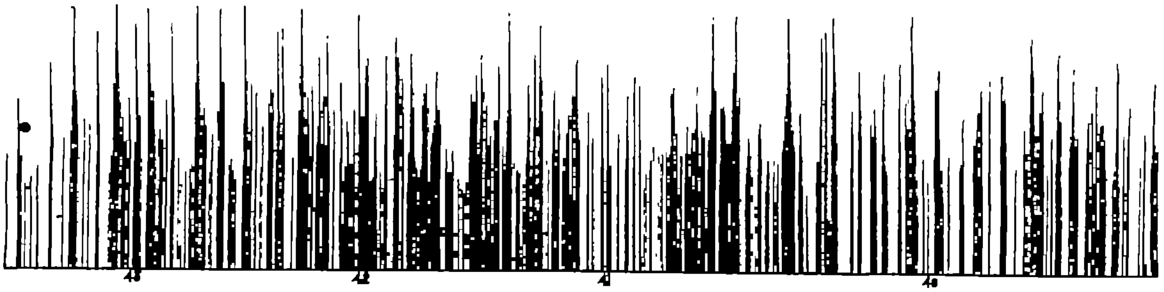


FIG. 3.—Copy of a photograph of the long and short lines of iron between wave-lengths 4,000 and 4,300.

A second stage of heat at least is therefore required to get a line spectrum. If I take sulphur, dealing with it by means of absorption, and heat it, I get a continuous spectrum at the first stage. I increase the heat to the second stage, what do I get then? A line spectrum, as I do in the case of sodium? No! A spectrum like that of the star in the constellation Hercules, not a line spectrum at all. I apply still a higher, a third, stage of temperature and then I get a line spectrum. In the case of the metalloids we have thus three stages of heat with three spectra. If there is such a thing as a particle at all, are we not justified in asking whether there is not some difference between the "particular" arrangements of the metalloids, from those of the metals? and some connection between temperature and the "atomic weights" of the chemist?

Before I go further I will throw these results into a tabular form, which will show you that through these various heat stages in the case of metals like sodium there is a great preponderance of line spectrum, and in the case of metalloids like sulphur there is a great preponderance of channelled space spectrum.‡

	Na.	Cd	S.
Fifth stage—spark	line spectrum	line	line
Fourth stage—arc	line	line	channelled space
Third stage—white heat	line	(?)	channelled space
Second stage—bright red heat	line	¶continuous absorption in the blue	channelled space
First stage of heat—dull red heat	line	continuous spectrum	continuous absorption in the blue

8. I next state that *A compound particle—that is a particle consisting of two distinct elements—has a vibration which is as peculiar to itself as the vibration of a particle of an element is peculiar to itself.* Thus the salts of strontium have each a distinct spectrum. Take the particle of N_2O_4. The absorption spectrum of this gas you now see on the screen. This particle has a vibration quite of its own. Now it is a gas which it is perfectly easy to dissociate. It is easy to turn it from N_2O_4 to NO_2. We introduce a new spectrum. These facts—and they might easily be multiplied—show then that a compound particle is a perfectly distinct physical thing, with vibrations, rotations, and free paths of its own. There is no apparent connection between the vibrations of a compound particle and those of any of the substances which make up that compound particle.

9. I now come to another important point: *On the whole certain kinds of particles affect certain parts of the spectrum.* Take the bright lines of the metals; if you were to mix together all the known metals in the sun, make a compound which should consist of all of them, put it into the lower pole of an electric lamp and photograph the spectrum, then you would find the majority of the lines would be in the violet end of the spectrum, scarcely any in the red end. That is the reason why the spectrum of the sun, which contains so many of the metals, is so complicated in the violet. If you combine a metal and a metalloid, you will find, in many cases at all events, that the vibrations will lie in the red end of the spectrum; you will also find that there is a connection between the atomic weight of the metalloids and the region of the spectrum in which their lines appear under similar conditions.

You have, in fact, simple particles and short waves, compound particles and long waves. Nor is this all. In many cases we find both ends of the spectrum, and in many cases the more refrangible end only, blocked by continuous absorption. This occurs so often in absorption spectra that one is led to suspect that it is due to some arrangement of particles.

10. Here is another proposition: *In the case of metalloids, and compound gases containing them, the spectrum to a large extent depends upon the thickness of the vapour through which the light passes, and often, if not invariably, the absorption increases towards the red end as the thickness is increased.*

Here is one of the points of the most extreme theoretical importance, and one about which least is known. There is a statement in Prof. Maxwell's book, that if you take a metallic vapour and employ a great thickness of it, you will get from it the same spectrum as you would from a small thickness of great density. This is Prof. Maxwell statement; I venture to think that this is somewhat doubtful, for in questions of thickness the spectroscope can offer the physicist a million of miles or a millimetre to work with, and one would think that such a difference should be enough. If I had a tube with a bore of the size of the lead in this pencil, and had some hydrogen gas rendered incandescent, you would see a line of a certain thickness, with a certain pressure. Looking through the sun's coronal atmosphere in an eclipse, you pierce seven or eight hundred thousand miles of hydrogen gas. The thickness of the lines is the same. Various thicknesses of sodium vapour do not alter the thickness of the lines. But if we pass from metals to the metalloids, then certainly one is prepared to go on with the professor to any extent. I can show you how true his statement is photographically. There is considerable interest attached to the question whether there is or is not any chlorine in the sun's outer atmosphere. I have endeavoured to settle this question, contrasting the absorption chlorine spectrum with the solar spectrum; different thicknesses of chlorine have been employed. It seems that, if we take the metalloids, the absorption of a small thickness often takes place in the violet portion of the spectrum.

---

* Continued from p. 7.

† Since this lecture was delivered Prof. Roscoe has established the existence of new spectra of sodium and potassium closely resembling the well-known ones of the metalloids.

‡ Since this lecture was delivered I have carried this branch of the research much further, and it seems one well deserving of the attention of physicists and chemists, as when it comes to be acknowledged that different classes of spectra do truly represent different "particular" aggregations, the contrast between the extremes of metals and metalloids will be beyond question. The result marked thus ¶ I have added from later work.—J. N. L.

* By an oversight last week the illustration here referred to was inserted instead of the present one.—J. N. L.

Now can these results be harmonised? Here I acknowledge we tread on very difficult ground, and with our present knowledge it would be perhaps best to say nothing; but I am not sure that this would not be scientific cowardice, so I will ask, under all reserve, whether the following explanation may not be a probable one? With metallic vapours the lines, though not widened as they are widened by great density, are certainly darkened, but all the lines are not visible—only the longest, generally. Now if we assume that the channelled space spectrum of the metalloids is really, even where it appears continuous, built up of lines,* then the darkening of these lines by greater thickness will not only make those darker that we see with a small thickness but bring others into visibility; and if this goes on till we have a very great thickness we may have an immense difference in the appearance of the spectrum.

11. *Some of the vibrations are very closely connected with others, as evidenced by repetitions of similar groups of lines in different parts of the spectrum.*

Here we are brought face to face with a revelation of the vibrations of particles, which, if I am not mistaken, will be made much of by the mathematical physicist in the future.

I will content myself by giving two or three striking instances, first noticed by Mascart. You will see that the longest line is at work in all of these.

In sodium we may say that the longest line is double; I refer to D′ and D″. All the lines are double.

In magnesium the longest line is a triple combination. This is repeated exactly in the violet.

In manganese we may almost say that the same thing happens, but the phenomenon is much more absolute in the case of those particles such as sodium and magnesium, which, on other grounds, I suspect to be of the simplest structure.

12. *Our knowledge of the vibrations of particles will be incomplete until the vibration is known from the extreme violet* (*invisible*) *to the extreme red* (*invisible*). In the meantime great help may be got from inferences, and, in the case of metalloids at low temperatures, from the position of their continuous absorption; and it is a question whether light may not be thus thrown upon the opacity of some solid substances and the transparency of others.

I think it not too much to say already, that in the case of some gases and vapours which are apparently transparent it is as certain in some cases that their absorption is in the ultra red, as it is certain that in the case of others the absorption is in the ultra violet. And further it is probable that this absorption is of the continuous or channelled space kind—in other words that no gas is "atomic" in the chemist's sense.

13. *From the fact that we have lines in the spectra of compound gases, it would be hazardous to affirm that the aggregate, which, with the highest dissociating power we can employ, gives us line spectra, could not be broken up if a still higher dissociating power could be employed.*

This proposition has a bearing on the celestial rather than on the terrestrial side of the inquiry, and as my time is drawing to a close I will refrain from enlarging upon it.

There is another branch of the research I am anxious to bring to your notice. I can do this better by experiment than by a simple statement.

The substance which you see here is a piece of gold leaf; it is yellow, as you know, but gold is sometimes blue and sometimes red. It must be perfectly clear to you, that if particles vibrate the colours of substances must have something to do with the vibrations. If the colours have anything to do with the particles it must be with their vibrations. Now as the spectrum in the main consists of red, yellow, and blue, the red and the blue rays are doing something in a substance which only transmits or reflects the yellow light; put the gold leaf in front of the lime light, you will see whether the yellow light does or does not suffer any change. The yellow has disappeared; you have a green colour; the red and blue are absent. The gold leaf is of excessive thickness. What would happen could I make it thinner? Its colour would become more violet. This I have proved by using aqua regia. But here is a solution of fine gold, which lets the red light through. Its particles are doing something with the blue vibrations, or *vice versâ*. Now what is the difference—the "particular" difference between the gold in this solution which is red, and that which is yellow by reflected, and green or violet by transmitted light? It is a question worthy of much study, especially in connection with my ninth proposition. Here are some more experiments. Here is some chloride of cobalt, which is blue. I will put it in this test-tube, to which I will now add water. You see it turns red. I content myself by asking why it turns red? We take some chloride of nickel, which is yellow, and put it into another test-tube: we add water, and I think you will soon see it turns green. First question—Why this change? Second question—Has the green colour of this solution anything to do with the red colour of the solution of gold?

I ask these questions because I believe the spectroscope will in time answer them.

I hope you will acknowledge that the spectroscope has to a great extent vindicated the theory stated by Prof. Maxwell. The question is, Has it taken us further? Perhaps not yet, but I think it will be found that what chemists picture to themselves as the atom, as contradistinguished from what they weigh, and physicists the molecule, is that particular atom, molecule, particle, or whatever name you may choose to call it, which with high-tension electricity gives us a spectrum of lines. You recollect that I said that in many of the monad metals it was obtained in the first stage of temperature; in the case of the dyads and metalloids with higher stages. If the true atom be that which gives a line spectrum, many anomalies will fall to the ground. These are questions the spectroscope raises. If you allow that in the line spectrum an atom is at work, in channelled spectra and continuous spectra molecular aggregations, you will see at once that Prof. Maxwell and others will be able to get a much sharper definition of atom and molecule than they have now; and though atoms are little things, you know they lie at the root of everything, and time spent in investigating them will not be lost.

J. NORMAN LOCKYER

A BOTANICO-GEOLOGICAL EXCURSION INTO THE GRAMPIANS

THE Scottish Alpine Botanical Club is wont to hold a spring meeting for mingled plant-hunting and conviviality in some Highland district where the Alpine flora can be reached at not too great a distance from oatcakes and whiskey. The Geological class in the University of Edinburgh is in the practice of terminating its labours for the winter by taking an excursion of a week's duration to some part of the country where professor and students can find interesting rocks, with enough of food (such as it may be) to eat, and of beds, or shake-downs, to sleep on. This year the two bodies, drawn together perhaps as much by animal spirits as by scientific enthusiasm, coalesced and held a conjoint gathering at Clova—a lonely hamlet on the Forfarshire Grampians, well known to botanists for the richness of its Alpine flora, and to geologists for its glacier relics and its ancient metamorphic rocks. The following notes by the respective leaders of the plant-seekers and the rock-hunters were communicated to the Edinburgh Botanical Society on the 14th ult.:—

1. *Botanical Notes by Prof. Balfour.*—On Friday, April 24, the botanists visited the lower part of Glen Fee and the western side of Glen Dole. They specially examined the rocks in Glen Fee, where *Oxytropis campestris* grows and along with the plant took specimens of the rock for the determination of the geologists. They also visited

---

* Thalen's beautiful researches on the spectrum of iodine quite bear out this view.

the rocks at the upper part of Glen Dole, where *Astragalus alpinus* grows. These rocks are very rich in plants; they consist of remarkably twisted and contorted gneiss, specimens of which were collected. The vegetation of the glen was in an advanced state, and some plants were gathered in flower which rarely blossom so early. Among them may be mentioned—*Arctostaphylos uva-ursi*, *Vaccinium vitis-idæa*, *Anemone nemorosa*, *Saxifraga oppositifolia*, forming large pink patches on the rocks; *Luzula campestris*, *Empetrum nigrum*, *Eriophorum vaginatum*, and *Cardamine hirsuta*. Among the other plants noticed in flower in the glen at Clova were: *Ulex europæa*, *Sarothamnus scoparius*, *Genista anglica*, *Prunus avium*, and *Ranunculus ficaria*. Among the plants not in flower which attracted notice were: *Silene acaulis*, *Saxifraga hypnoides* and *aizoides*, *Draba incana*, *Pyrola media*, *rotundifolia*, *secunda*, *Oxyria reniformis*, *Gnaphalium supinum*, *Dryas octopetala*. The following ferns were also gathered: *Lastræa oreopteris*, *Athyrium filix-fœmina*, *Polystichum lonchitis*, *P. aculeatum*, *Polypodium alpestre*, *P. vulgare*, *Asplenium viride*, *A. trichomanes*, *Botrychium lunaria*, and *Allosorus crispus*. All the species of British Lycopods except *inundatum* were gathered. Mr. W. B. Boyd collected some good mosses, including *Trichostomum glaucescens*, confined to the rock in Glen Fee on which *Oxytropis campestris* grows. It occurred in considerable abundance and in fruit.

On Saturday 25 the party again went to Acharne, and thence up Glen Esk to Bachnagairn, and by Loch Esk to the White Water and Little Gilrannoch. Again the day was all that could be desired. The snow near the summits of the hills was very refreshing, and on one we had a sufficient extent of snow to give us the benefit of a glissade with our poles. This day the botanists and geologists kept together. We specially examined Little Gilrannoch, one of the rocky summits which is interesting as yielding the *Lychnis alpina*, one of our rarest Alpine plants, and associated with it dwarf specimens of *Armeria maritima* and *Cochlearia officinalis*, the Alpine variety, and *Luzula spicata*. The rocks were specially examined by the geologists.

On Monday 27 the botanists examined Loch Brandy and Loch Wharral, and the rocks around them. We noticed particularly the vast crevasse formed at the top of the Snubb by the separation of a great mass of rock, which is gradually giving way, and will ultimately be precipitated into Loch Brandy. *Saxifraga oppositifolia* was seen as formerly in fine flower. *Azalea procumbens* was also gathered. In Loch Brandy *Isoetes lacustris* and *Lobelia dortmanna* were met with. In ascending the mountains this day we saw a fine effect produced by the thick white mist resting in the valley, while we were on the mountain above it enjoying clear sunshine. Among the mosses collected by Mr. Boyd during the trip may be noticed—*Grimmia unicolor*, *G. donniana*, *Leucodon morensis*, *Andræa campestris*, and *Hypnum catenulatum*.

2. *Geological Notes by Prof. Geikie.*—The main object of the geologists of the excursion was to observe some of the phenomena of the metamorphism of the district, to note the more prominent minerals, to trace the remains of old glaciers, and to connect the general structure of the rocks with the forms of hill, valley, crag, and ravine into which they have been carved. Incidentally, however, they took part in some of the botanical work, their attention being specially directed to the Alpine flora and to the circumstances under which some of the rarer Alpine plants occur. There can be no doubt that, as pointed out by Edward Forbes, our Alpine flora is descended from that which was general over these islands during what is known as the last Ice age. It has been supplanted in the lower districts by the vegetation which has come in with a milder climate; and it survives on the bleak and cold mountain ridges only so long as it can find its congenial temperature there, or so long as the chills and mists of these high regions forbid the further ascent of the plants which, swarming over the country, have driven these northern forms step by step up into these high grounds. It is well-known that the Alpine flora is richer in individuals and in species in the eastern Grampians than anywhere else in Britain. A number of plants are found in no other part of the country, and even in that district several are restricted to mere isolated rocks in some glen or some bare mountain brow. The question proposed to the consideration of the geologists was whether any geological reason could be given for this remarkable distribution; and particularly whether or not the nature of the rocks had had anything to do with it.

Some attention was accordingly paid to the habitat of three of the rarer and more local species. The *Astragalus alpinus* was observed on hard quartzose schist, high up in Glen Dole; the crag on which the *Oxytropis campestris* flourishes is a mass of singularly twisted and gnarled quartzose gneiss, with hard siliceous ribs projecting from its surface and showing the crumpled nature of the rock. But in neither of these cases does the rock apparently differ from many other crags in the neighbourhood, where the peculiar plants nevertheless are not found. In the case of the *Lychnis alpina* a special case seemed at first to be made out in favour of a relation, or at least a coincidence of a local plant with a local rock; for the locality noted as the habitat of this rare plant was found to present shattered knobs of serpentine projecting through the turf, and on these knobs the *Lychnis* grows, together with the *Cochlearia officinalis* and the *Armeria maritima*. This rock was not observed by the party *in situ* in any other part of the district examined. Before it was quitted, however, one of the botanists, who strayed farther over the mountain, returned with a piece of mica-schist, as the rock on which the same plants were found growing only a short distance away. It appeared, therefore, probable that, at the most, difference of rock can have had but a very slight influence in the survival and present distribution of the Alpine flora.

A much more effective influence may be traced to the general physical geography of the country, and especially of the eastern as contrasted with the western districts. The richness of the Aberdeenshire and Forfarshire mountains in Alpine plants, as contrasted with those of equal elevation in Invernesshire and Argyllshire, has long been a familiar fact to botanists. The cause of this contrast seems referable not to any difference in rock and soil, nor to mere differences in height; it appears to be explicable by the much greater breadth of high ground in the east than in the west. Everyone who has ascended some of the Grampian ridges remembers the wide undulating moors which spread out before him at heights of 2,000 or 3,000 ft. The summits are not peaks, so much as huge swells or mounds rising higher than the rest of the vast tableland. In the western counties, however, the craggy mountains tower often into sharp ridges. They are deeply trenched by glens and arms of the sea, so that relatively a smaller area of land rises out of the ordinary lowland vegetation into the chiller regions above. Add to this that the Invernesshire and Argyllshire hills lie nearer to the warm winds and currents of the Atlantic, and that the Grampian uplands receive the prevalent south-westerly winds after they have been chilled by passing over many leagues of high cold mountain ground. It is in these eastern parts of the Highlands that snow lingers longest, widest, and deepest— a good index, indeed, of the greater severity of the climate. These facts are suggested as affording some explanation of the comparative abundance of the Alpine flora in that part of Scotland.

Why in that limited district certain plants should be restricted to mere isolated rocks is a question to which no intelligible and satisfactory answer can at present be given. But even more perplexing is the problem presented by the survival of maritime plants upon some of the highest and bleakest mountain-tops. In such portions the *Cochlearia* or scurvy grass, the *Armeria* or sea pink, with *Silene maritima* and *Plantago maritima*, are found abundantly. They are poor dwarfed forms, it is true, when compared with their contemporaries on the coast, so that the latter habitat is evidently more congenial to them than the bleak uplands. Descendants of the old arctic flora once indigenous in this country down to the sea-level, as it is in northern Scandinavia at the present day, how have they come to be left on our mountain tops? Were they maritime plants originally, and have they been carried up by the gradual elevation of the land? This would involve a former submergence of the country to a depth of at least 4,000 ft.—a limit much beyond that suggested by other geological evidence. Or did they form part of the generally distributed flora whereof some species keeping to the shores have been able amid bare rocks and salt spray to maintain themselves there ever since, while farther inland they have succumbed to the march of the invading Germanic flora, and have been allowed to struggle on in dwarfed and stunted forms only on the bare chill mountain tops, whither the invaders did not care to pursue them?

Some light might possibly be cast on these questions by an examination of the contents of our older peat-mosses. There is reason to suppose that some of these mosses may date back into Glacial times. It would be interesting to discover whether among the plants whose remains went to form the peat any northern species could be detected no longer living in this country, even in our Alpine zone. This line of inquiry is now being prosecuted in Scandinavia, and it is suggested to the botanists of Scotland as a fit subject for their attention.

The more purely geological work by the brethren of the hammer during this excursion, whether when with the botanists among the Grampians or afterwards by themselves along the shore between Dunnottar and Aberdeen, is hardly appropriate in a communication to the Botanical Society.

ON THE FERTILISATION OF CERTAIN LABIATÆ

IN the early part of April of the present year I had an opportunity of watching somewhat closely the mode of fertilisation of some species of Labiatæ, on which some notes may be interesting. The species observed were the three most abundant of the early flowering representatives of the order, *Lamium album*, *L. purpureum*, and *Nepeta glechoma*; the post of observation a bank covered by the three species growing completely intermixed, just outside a cottage-garden where were several hives of bees; the time occupied, several hours on three sunny mornings. The point which interested me most was the constancy with which the same species of insect confined its visits to the same species of flower, notwithstanding the close proximity in which the three were growing, this being perfectly in harmony with Mr. Traherne Moggridge's observations of a similar character respecting the visits of insects to fumitories and other flowers.

My conclusion is not based merely on actually noticing the visits of insects, but on the microscopic examination of the pollen collected on the captured insects. For this purpose the pollen-grains of the three species named offer unusual facilities, those of *Lamium album* being yellow, of *L. purpureum* red, and of *Nepeta glechoma* white.

In *Lamium album* the length of the style is such as to bring the stigmatic surface exactly on a level with the anthers of the shorter pair of stamens, as represented in Fig. 1; one branch of the style is nearly straight and is hidden among the anthers, the other projects at right angles into the opening to the tube of the corolla, so that it must necessarily be struck by any insect entering the flower. The only visitors to the flower seen were two species of humble-bee, *Bombus pratorum*[*] (female) and *Anthophora retusa* (female), the former in large numbers, the latter much more rarely. From the position of the stigmatic surface, both it and the stamens must be struck by about the centre of the head of the bee; and it was on this part that the greater number of pollen-grains were found, and proved to belong exclusively to this species. In no single instance was a hive-bee seen to visit the flowers; Müller states that they obtain the honey from this species entirely by sucking it through holes bitten in the corolla by *Bombus terrestris*.

In *Lamium purpureum* the difference in length between the two pairs of stamens is less considerable and the anthers are consequently closer together, both branches of the style being bent forwards into the mouth of the corolla, as shown in Fig. 2. Although hive-bees were constantly hovering over the flowers, in no single instance did I see either them or the humble-bees visit this species; the only insect observed to settle on it being a butterfly (*Vanessa urticæ*) twice.

The position of the parts in *Nepeta glechoma* is very different. The two pairs of anthers are at a considerable distance from one another (Fig. 3), and the length of the style is such as to bring the stigmatic surface considerably beyond the longest pair, and projecting beyond the mouth of the much smaller corolla. The flowers were profusely visited by the hive-bees from the other side of the hedge. On no single occasion did I see the *Bombus pratorum*, of which such numbers were flying about, even attempt to enter the flower, and the smaller species, *Anthophora retusa*, only twice; and on each of these occasions she immediately came out again and began industriously to wipe the pollen off her head with her fore-legs, as if she disliked it. Owing to the much smaller size of the flower, and the greater length of the style, the part of the body of the bee touched by the stigma is very different to that in the *Lamium album*, namely, the back of the neck or even of the thorax. Hence even if the insect should visit the two species on the same journey—which, I should infer, is not usual—the pollen of one species would not easily be wiped off on to the stigma of the other. I did not observe any plants of the ground-ivy with the "female" flowers described by

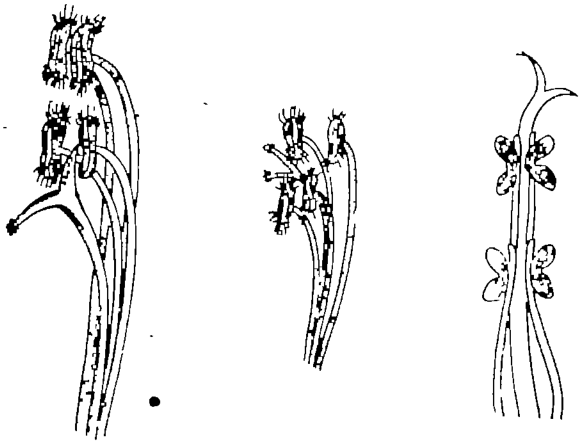


FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—*Lamium album*; stamens, style, and stigma. FIG. 2.—*Lamium purpureum*; stamens, style, and stigma. FIG. 3.—*Nepeta glechoma*; stamens, style, and stigma.

---

[*] In this and all other instances I am indebted for the determination the insects to the kindness of my friend Mr. Edward Newman.

Muller, with which one is familiar in the case of the wild thyme and other Labiatæ; but a large number of flowers in this particular locality had all the anthers bitten off, a depredation which I attributed to the hive-bees, inasmuch as the same was the case in other habitats near hives, but not in those at a greater distance from cottage-gardens. The only other flowers growing on or near the same bank which I observed the bees to visit were the dandelion several times, and *Veronica buxbaumii* once.

At this early period of the year the following species of insects were captured on the dandelion; those marked with an * are not in Muller's list of ninety-three kinds which visit this plant, unless under synonyms which I fail to recognise.—Hymenoptera, *Apis mellifica*, **Halictus lugubris*, **Andrena nana*, *A. varians*, and *A. nitida*; Diptera, **Syrphus clypeata* and *Eristalis arbustorum*; Coleoptera, **Apion apricans*.

The sloe was abundantly visited by **Andrena fulvicrus* (Hymenoptera), both male and female, and by *Eristalis tenax* (Diptera). On opening the abdomen of the latter, it was found to contain abundance of pollen-grains, belonging to the species on which it was then feeding, and to the dandelion, mixed with a few larger triangular pollen-grains, belonging apparently to a Fuchsia; thus confirming the opinion at which I had previously arrived, that the Syrphidæ are large consumers of pollen. The abdomen of the Hymenoptera, on the other hand, contained but a very few pollen-grains, which might easily have been sucked up accidentally along with the nectar; and this was also the case with the hive-bee, the grains in this latter case belonging to the dandelion.

ALFRED W. BENNETT

NOTES

THE Cambridge Museums and Lecture Rooms Syndicate, in their eighth annual report state that the Regius Professor of Physic has again called their attention to the urgent need of better accommodation for the medical examinations. Among the additions which have been made to the collections in the several museums, the bequest of the late Mr. M'Andrew, F.R.S., of the whole of his collection of shells and other specimens, deserves the first mention. It is of the highest scientific value. A most interesting collection of human crania, made by the late Dr. Thurnam, of Devizes, has been presented to the Museum of Human Anatomy, through the liberality of Prof. Humphry. A series of Devonian fossils, of great beauty, presented by Lady Burdett Coutts, deserves special mention, as also does the contribution of several hundred specimens of Palæozoic and other fossils by Prof. Hughes, and the gift of 500 sterna of birds by Prof. Newton and Mr. E. Newton, and of a skeleton of the extinct bird "the Great Auk" by Prof. Newton. The building of the Cavendish Laboratory is now finished, and the Laboratory is open for practical instruction in physics. As the several collections and the number of students in the several departments increase, the current expenditure necessarily increases. The Syndicate are therefore of opinion that the time has arrived when they are obliged to call the attention of the Senate to the necessity of increasing the amount of the annual grant to the museums and lecture-rooms maintenance fund. They suggest, however, that for the current year a special grant of 300*l*. be made to the fund. Appended are the reports of Professors Humphry and Newton, and of the Superintendent, Mr. J. W. Clark, which give details of the past year's work and the additions made to the various collections.

IN a Convocation at Oxford, on May 28, the name of H. S. Smith, F.R.S., Savilian Professor of Geometry, Fellow of Corpus, who had been nominated to the office of Keeper of the Museum, by the delegates, in succession to the late Prof. Phillips, was approved.

THE list of those on whom the honorary degree of LL.D. is to be conferred at the approaching Cambridge commencement is very numerous. We have already mentioned some names; the following is a list of the men connected with Science who are to receive the honour:—Sir Charles Lyell, F.R.S.; Sir James Paget, F.R.S.; M. Leverrier, of the Paris Observatory; Joachim Barrande, of the Royal Society of Sciences of Prague; George Bentham, F.R.S.; and William Lassell, F.R.S.

WE have received the prospectus of a new "College of Science and Literature," which it is proposed to establish at Bristol for the South and West of England and South Wales. Such an institution, if properly organised, would no doubt be of great service, as these extensive and important districts are far distant from any college in which the sciences applied to their various industries can be studied. Judging from the prospectus, the organisers of the scheme have sound notions of what such an institution ought to be, keeping in view as models Owens College and the Newcastle College of Science. Balliol College and New College, Oxford, have come very liberally forward in aid of the scheme, having offered to contribute towards it 300*l*. a year for five years. It is estimated that a capital sum of 25,000*l*. will be required, and an annual subscription of 3,000*l*. for the first five years secured. It is, however, proposed to commence operations when such proportion of these amounts has been guaranteed as may justify the expectation of success. A public meeting is to be held at Bristol on the 11th inst. to inaugurate the undertaking, which we sincerely hope will be taken up heartily by those interested in it.

MR. W. SAVILLE KENT, F.L.S., the late Superintending Naturalist of the Brighton Aquarium, and formerly Assistant in the British Museum, has been appointed to the control of the Manchester Aquarium. This aquarium being constructed on the "circulating" principle, advocated by Mr. Kent, and it being, moreover, intended to make the building subservient more to the instruction and education of the masses rather than for the realisation of extraordinary dividends, we may anticipate from it scientific results of the most gratifying sort. The tank frontage of the Manchester Aquarium presents a length of no less than 750 ft., an amount exceeding that of any aquarium yet constructed. An ample guarantee of the encouraging support this undertaking is likely to receive at the hands of the public is shown by the returns for the first week of its opening, the visitors who passed through the gates during that period numbering over 19,000.

THE Birmingham Natural History and Microscopical Society, whose enterprise we have had frequent occasion to speak of, is contemplating the foundation of an aquarium in Birmingham, and has been seeking information from the managers of various aquaria at home and abroad. The result is not altogether encouraging to those who desire to see an aquarium standing on its own legs as a scientific institution, apart from adventitious attractions. It seems that scarcely any existing aquarium pays that is not attached to or does not form part of some place of amusement; and Mr. Lloyd of the Crystal Palace Aquarium gives it as the result of his large experience that no aquarium can be made to pay its way, unassisted by other attractions, even in the largest centre of population, unless its cost be limited to 3,000*l*. and its annual expenses to 500*l*. Still we hope that, whether as an independent or as a parasitical institution, the Birmingham Society will be brave enough to take steps to establish an aquarium in that busy centre.

FROM the Twelfth Annual Report of the Birmingham Free Libraries Committee, we are glad to see that this system of libraries continues to enjoy increasing prosperity. These annual reports furnish a number of very interesting statistics as to the number and class of books in the libraries, number and occupation of readers, books most in demand, &c. The total number of books in the various libraries amounted at the end of last year to 69,279, a very large proportion of which are of a scientific character. From the statistics as to books most sought after, and the number of readers in the various subjects, we are glad to see that works of Science enjoy a large amount of patronage. The aggregate issue of works in the reference and lending libraries was 525,610.

We have received several American papers containing descriptions of a marine aquarium in San Francisco, California. It forms part of the many attractions of "Woodward's Gardens," an extensive piece of ground which has been inclosed and laid out by a private gentleman, Mr. Woodward, for the amusement and instruction of the people.

It is gratifying to learn that the lamented death of Prof. Agassiz will not prevent the continuation of the school of natural history at Penikese Island, the results of which during the season of 1873 proved to be of so much educational importance. A circular from Mr. Alexander Agassiz in regard to this states that two or three times as many persons as can be accommodated have already applied to be received during the coming summer, and that great interest is manifested to prosecute the study of nature under the eminent specialists who have been called to assist in the enterprise. The necessity of a permanent endowment is very justly set forth by Mr. Agassiz, and especially the importance of means for paying for the services of the men of science invited to officiate as instructors. He suggests that provision be made by the Legislatures of the several States for the endowment of scholarships, either by the actual payment of the sum of 5,000 dols., or an annual grant of 350 dols. The payment of this sum on the part of any State would entitle it to nominate two teachers for admission during the summer to the Penikese school, the selection to be made from among those most apt in natural history. No charge is made to the students of this school for tuition. It is announced that this school will open on July 7, and close on Aug. 29. Among the gentlemen mentioned as likely to take part in the instruction are Dr. Packard, Professors Wilder, Morse, Mayer, and Jordan, and Messrs. Putnam, Bickmore, Lyman, and others.

The Annual Report of the Trustees of the Museum of Comparative Zoology at Harvard College, Cambridge, U.S., shows that that institution is rapidly becoming one of the first of its kind anywhere. Its already large and valuable collections are constantly being added to, and rapid progress is being made in their systematic arrangement. The museum is open not only to regular students of natural history, but to all scientific men who care to make use of it in aid of their researches. It is in connection with the Harvard Museum that the Penikese School of Natural History was instituted; and, between the two, American students have rare advantages for the study at least of Icthyology.

The German Society for Polar Exploration has, it is said, purchased the harbour of Kristvig, on the Island of Averio, on the west coast of Norway, with the intention of making this in future the starting-point of German explorations of the Arctic regions.

Dr. Gross, the author of "Les habitations Lacustres du lac de Bienne," in which all the stations in that lake of the Stone and Bronze ages are described in detail, has just, says the *Continental Herald*, presented a gem of its kind to the Archæological Museum of the Berne City Library. This is a hatchet of nephrite, 7 in. long, a very scarce kind of stone, and only found in eastern Asia, the occurrence of which in the lake dwellings of Switzerland forms an unsolved puzzle.

The first ascent of a balloon over the Black Sea was made on April 19 from Odessa in the "Jules Favre," measuring 70,000 cubic feet. The ascent took place at 3.10 A.M. in a north-east direction; but as it mounted higher the wind veered and the balloon went out to sea in a south-east direction. It rose to a height of 7,000 Russian feet at a distance of about 16 miles from land. The balloon came to ground at Peresadovka, about 20 miles north from Nikolaeff, at 6h. 39m. A.M.

As the series of annual international exhibitions at South Kensington is to be discontinued after the present year, the Society of Arts have in consideration the organisation of a series of provincial exhibitions of an industrial character, to be held in the centres of the manufacturing districts. The plan is as yet by no means complete, but a principal part of it would be that the special industries of each locality should be, as far as possible, illustrated in its exhibition.

A public meeting was held in the Mechanics' Institute, Nottingham, on Tuesday night, to consider the further development of the movement instituted by the Cambridge University for extending its teaching to the masses of the people. The report of the committee for the past session stated that nearly 2,000 tickets for the lectures and classes were applied for in the town; 1,241 persons attended the lectures, and 615 the classes. There were 143 candidates at the examination, of whom 126 obtained certificates of merit. The financial statement was satisfactory, and the report expressed a belief that the movement would shortly be self-supporting.

At a recent meeting of the Royal Geographical Society of Ireland Mr. W. Harte, County Surveyor, co. Donegal, gave a description of "Supposed evidence of a recent change of level in the surface of co. Donegal." He adduced a number of proofs that there was a general and rapid depression in the surface of the county. Inhabitants had informed him that portions of the coast now covered with 20 ft. of water had been passed over dry-shod by their grandfathers. Many bogs also, of which the trees were still erect and *in situ*, had been recently inundated. That the water had never previously reached a higher level he proved from the fact that none of the bogs now under water had ever been previously inundated, for they were not permeated, as bogs which had been covered by water invariably were, with a fine microscopic sand. The submergence of Donegal was taking place at a rate that was much more rapid than had been suspected; old passes which were used to islands along the coast now no longer existed. The most interesting fact, however, was one brought to light by Mr. Fitzgerald, who found numerous cases of furnaces used by the ancient Irish to smelt the bog iron ore, but which were now under high-water mark.

The ravages caused by the *Phylloxera vastatrix* among the vineyards of France are becoming very serious. More than 150 various remedies have been tried but without success, and the only hope of many scientific men is in the introduction of varieties of vine which are known to be to a certain extent proof against the attacks of this insect. Many American kinds of vine are said to possess the property of resisting the disease for a much longer time than the French vines, and steps are being taken to introduce roots of these varieties into France. In the Department of Hérault alone the produce of wine has fallen from fourteen millions of hectolitres to eleven millions: not only is the fruit destroyed by the effects of the parasite, but the vine itself is destroyed in a year or two; and one female Phylloxera is said to produce two or three millions of young in a year.

At a recent meeting of the Boston Society of Natural History Prof. Morse read a paper on Natural Selection among the Mollusca, instancing the usually small size of certain species in the

Bay of Fundy, near Eastport. Here the tide rushes along with great power, and the molluscs are obliged to cling to the bottom with great tenacity to prevent being swept away. Only the smaller individuals can withstand this by getting into the crevices of the rocks. The species is thus perpetuated by the smaller members, and rarely attains any considerable size.

THE Inspectors of Salmon Fisheries of England and Wales have just issued their annual report. Examples are given of the serious injuries inflicted on salmon rivers—and not only on salmon rivers but on the health of the public—by the pollutions poured into rivers, and it is to be hoped that powers will be given to enforce the removal of such matters from our streams. Altogether the prospects of our salmon rivers appear very favourable, and much good is to be expected from the working of the new Act.

A SEAM of coal has been discovered at Sandwell Park, near Birmingham, 418 yards below the surface.

SOME good popular scientific lectures are at present being given by Prof. Gardner at the Polytechnic.

THE May number of *Annals and Magazine of Natural History* contains, among other articles, a list of butterflies taken by Lieut. Bell on the march to Coomassie, with a description of six new species. Dr. Nicholson describes a new genus of Palæozoic corals from the Niagara group of Indiania, which he names Duncanella, in honour of Mr. P. M. Duncan. Dr. Young gives a description of a new genus of carboniferous Polyzoa, and suggests the name Rhabdomeson. A plate is given illustrating *Rhabdomeson gracile*. There is also a brief note of an apparently new species of humming-bird, of the genus Eriocnemis, by Mr. Elliot. The discussion about Eozoon is continued.

AN excellent device has been forwarded to us for use in field-club excursions. It is designed to promote an interest in common flowers, and can of course be varied and worked without a prize. It consists of a large envelope, with a description, but not the name, of a plant, and directions as to what ought to be done with the plant when found. The particular envelope, forwarded to us by Mr. Higgins of the Liverpool Naturalist's Club, contains the following on its back:—

EXTRA PRIZE.

DESCRIPTION OF PLANT.

Leaves opposite, Sessile, Lanceolate, Acuminate.
Sepals 5, half as long as the 5 deeply-cleft Petals.
Stamens 10, Styles 3, height about 12 in.

Members finding a plant answering to this description should take it to the President or Botanical Referee, with their name signed at the foot of this slip. When correct the slips will be initialed and handed to the Secretary. The finder should be prepared to answer questions on the description; but the name of the plant will not be officially announced till after tea.

A Prize or Prizes will be awarded at the end of the Season to those most successful.

Signed, ______________________

THE additions to the Zoological Society's Gardens during the past week include a Beisa Antelope (*Oryx beisa*) new to the collection, from Central Africa, presented by Admiral Arthur Cumming; an Indian Gazelle (*Gazella bennetti*), presented by Mr. J. H. Bainbridge; an Indian Ratel (*Mellivora indica*), presented by Mr. L. Macneill; a Maugé's Dasyure (*Dasyurus maugei*) from Australia, presented by Mr. F. Kirby; two Little Whimbrels (*Numenius minutus*) from the Navigator Islands, presented by Rev. S. J. Whitmee; a Guilding's Amazon (*Chrysotis guildingi*) from St. Vincent, purchased; a Bennett's Cassowary (*Casuarius bennetti*) from New Britain, deposited.

SCIENTIFIC SERIALS

THE *American Journal of Science*, May 1874.—The May number contains the following papers:—On the polarisation of light, by Prof. A. W. Wright. Prof. Wright instituted a series of observations with different instruments, which he describes, obtaining, however, only faint and uncertain results. At last he has been enabled to make observations he considers reliable. He obtained a quartz plate, cut perpendicularly to the axis, and exhibiting by polarised light an unusual intensity of colour. Examined with one Nicol and unpolarised light the plate is perfectly colourless, and shows no trace of its heterogeneous structure. Placed between two Nicols, it showed bands of colour, the plate being a macle, the body consisting of left-handed quartz, crossed by a band of right-handed quartz, bounded by strips of different structure. The plate was used in a tube 11 in. long, and formed an instrument especially adapted to the detection of small degrees of polarisation. The observations were made facing the south-west in a dimmed room, so that the eye should be sensitive. The results of the numerous observations on different evenings were entirely concordant, and are thus summed up by Prof. Wright:—(1) The zodiacal light is polarised in a plane passing through the sun. (2) The amount of polarisation is, with a high degree of probability, as much as 15 per cent. but can hardly be as much as 20 per cent. (3) The spectrum of the light is not perceptibly different from that of sunlight, except in intensity. (4) The light is derived from the sun, and is reflected from solid matter. (5) This solid matter consists of small bodies (meteoroids) revolving about the sun in orbits crowded together towards the ecliptic.—The second article is the first instalment of a communication by Mr. W. M. Fontaine, On the "great conglomerate" of New River, West Virginia.—The third article is by Mr. S. W. Johnson, On the use of potassium dichromate in ultimate organic analysis. Potassium dichromate, the author thinks, possesses all the properties needful for an oxidant in organic analysis, and ordinary kaolin is the best material for diluting it. He gives the details of some of his experiments.—Then follows an article by Mr. C. H. Hitchcock, On the Helderberg Rocks of New Hampshire, which is illustrated by a map, and is to be continued.—The Rev. H. C. Hovey contributes an interesting article on *Rabies mephitica*. The bite of the common skunk (*Mephitis mephitica* Shaw) is often dangerous, and leads to symptoms somewhat analogous to those which follow the bite of a mad dog. Mr. Hovey has obtained particulars of forty-one cases of *Rabies mephitica*, and of these forty were fatal.—Mr. Carey Lea of Philadelphia finds that when silver bromide is treated with pyrogallic acid, after exposure to light, the black substance which remains contains bromine and is resolved by nitric acid into normal silver bromide (left behind as a pale yellow film) and silver which passes into solution. It is, therefore, either a sub-bromide or an oxy-bromide; not an oxide. The existence of these compounds is evidently an argument for doubling the atomic weight of silver, as has recently been proposed on other grounds.—Mr. Meek continues his notes on the fossils figured in the recently-issued fifth volume of the Illinois state geological report.—The brief contributions from the physical laboratory of the Harvard College are also continued. They include No. v., On a method of freeing a magnetic bar from the influence of the earth's magnetism, by John Trowbridge. No. vi. Note on Melde's experiment, by W. Lowery. No. vii. A spark adjuster for the Holtz machine, by James Minot. No. viii. Effect of condensers on the brush discharge from the Holtz machine.—Mr. E. A. Verrill continues contributions to zoology, giving the results of dredging at three stations on the coast of New England, on Cashe's ledge, Jeffrey's ledge, and Stellwagen Bank.—In the "Scientific Intelligence," the section "Chemistry and Physics" consists of notices of papers published in Europe. In section "Geology and Natural History" there is a notice of a communication in the *Overland Monthly* On mountain sculpture in the Sierra Nevada, and on the method of glacial erosion, by E. S. Carr. He holds that glaciers do not so much mould and shape rocks as that they "disinter forms already conceived and ripe." The grain of a rock determines its surface-forms.—There is also an extract from a letter to Dr. Dana, referring to volcanic action in Hawaii, where Mauna Loa has been in full activity since April 1873.—An abstract is given of Prof. W. S. Clarke's experiments on the amount of pressure in the sap of plants. The mercurial gauge has been used on the sugar maple, and observations were made day and night from April 1 to July 20.

The maximum pressure was found to be equal to sustaining a column of water 31·73 ft. high. One of the most interesting portions of the experiments was to determine, if possible, whether any other force than the vital action of the roots is necessary to produce the sap-pressure. A black birch-tree was selected, and a root was severed at 10 ft. from the trunk, and to it was attached a mercurial gauge. This showed a maximum pressure equal to 85·8 ft. of water, and proved that "the absorbing power of living birch rootlets without the aid of any of the numerous helps imposed upon them by ingenious philosophers, such as exhalation, capillarity, oscillation, &c., was quite sufficient to account for the most essential of the curious phenomena connected with the circulation of sap."

Journal of the Franklin Institute, April.—The following are some of the important papers in the number:—Report of the Committee of the Institute on the Westinghouse car-brake. This brake in its simplest form consists of a small steam-engine placed in the locomotive, which, taking steam from the boiler, works an air-pump, which compresses air into a main reservoir, secured beneath the car. By an ingenious arrangement of pipes and automatically acting valves, the air is admitted into a series of brake cylinders, one under each car, the pistons of which are connected with and act upon the ordinary brake-levers, and thus apply the brakes to the wheels. The inventor has made important improvements on this, by means of which the compressed air may be admitted almost instantaneously into the brake-cylinders, and the train brought to a standstill in an incredibly short space of time; *e.g.* a train, going at the speed of thirty miles an hour up a gradient of 29·6 ft. per mile, was brought to a stop in 16 seconds. Scott's legacy, premium, and medal, were awarded to the inventor by the Institute.—The principles of shop-manipulation for apprentices is continued.—On the mechanical calculation of earthwork (or the results of physical measurements in general) according to the prismoidal or other formulæ, by C. Herschell, C.E. This paper relates mainly to the important uses to which the polar planimeter can be put.—Prof. R. H. Thurston contributes two papers which have been published separately: On the thermal and mechanical properties of air and other gas, subjected to compression or expansion; and On the strength, elasticity, and resilience of materials of machine construction; both papers are illustrated with diagrams.

THE *Journal of Mental Science* for April, opens with the third number of the Morrisonian Lectures on Insanity for 1873, in which Dr. Skae and Dr. Clouston still further exemplify the classification of the various kinds of insanity according to the bodily disease or condition with which they are associated. In speaking of Climacteric Insanity it is contended that men between 50 and 60 have a critical period corresponding to that passed through by women between 40 and 50; but the evidence seems far from conclusive. But nothing can be more striking and terribly instructive than the amount of insanity of one kind or another that is unmistakably connected with the organs and functions of generation.—The morbid psychology of criminals by David Nicolson, M.B., continues; and his observations on this unfortunate class are very valuable and well worth recording—especially perhaps may they prove useful "as a basis of comparison for kindred phenomena occurring in circumstances less definite and uniform." No one is likely to be very seriously injured by the common prison delusion "that their food is poisoned;" but if the same painful fancy take possession, as it sometimes does, of individuals in the outer world, it may not be so readily recognised as a delusion, and the consequences may be very mournful.—A psychological study of the character of Jean Jacques Rousseau, by J. Hawkes, M.D., suggests the idea of a washerwoman sounding the Atlantic with her clothes line, and finding it very shallow all over.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, April 1.—In this number Dr. Mohn furnishes a number of data from three years' observations of the temperature in and near Christiania—at the Institute and the Observatory—and of the decrease of heat with height; a station named Frognersæter having been chosen, situated about five miles NN.W. from the Observatory, and 408 metres above the sea. The air within the city is shown (as in other localities) to be warmer than without. The temperature in general decreases with the height, and most quickly in May; in the winter months the decrease is small, and it passes, in December, into an increase. Dr. Mohn studied the meteorological conditions present in three separate cases:—(*a*) Frognersæter warmer than Christiania; (*b*) colder and excessive; (*c*) change of temperature on fall of rain or snow. As regards (*a*), it occurred in cold weather; the wind N.E. or E., and light; atmospheric pressure about 7 mm. above normal; sky most often clear, but sometimes a mist covered Christiania, while Frognersæter was in sunshine. The author inquires at some length into the causes of change of temperature with height, and points out that the elements of greatest influence here are the strength of wind and the relative moisture. The change increases with the former and decreases with the latter. To this is joined the action of precipitates, in so far as this, accompanied by greater relative moisture, contributes to lessening the decrease of temperature with the height.—Prof. Ebermayer follows with a review (in part) of a new text-book of climatology by Dr. Lorenz and Dr. Rothe. From personal observation he disputes the authors' assertion that the increase of cells in plants takes place only by night.—Among the "Kleinere Mittheilungen," we note some meteorological observations from the north-west coast of Spain.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 7.—"Preliminary Experiments on a Magnetised Copper Wire," by Prof. Balfour Stewart, LL.D., F.R.S., and Arthur Schuster, Ph.D.

1. The following experiments were made in the physical laboratory of Owens College, Manchester:—

A copper wire was wound fifty-three times in one direction round the poles of a powerful electro-magnet, the length of wire encircling these poles being about twelve metres.

A Wheatstone bridge was employed to measure the resistance of the wire, and a very delicate Thomson's reflecting galvanometer, by Elliott Brothers, was likewise used.

Experiments were made at intervals of two minutes; and on each occasion the current was allowed to pass through the bridge for ten seconds, the measurement being taken by the first swing of the galvanometer, which lasted for about eight seconds. Three cells of Grove's battery were used for producing this current, but on the other hand six similar cells were employed for magnetising the electro-magnet.

2. In the first experiments made, the induction-current due to the wire coiled round the magnet affected the galvanometer, but after Dec. 12 a solid key put into the circuit was taken out, so that no induction-current passed.

The following is a specimen of the observations made:—

Dec. 17, 1873

Time of putting on current. h. m.	Whole deflection observed (increasing deflection denotes increasing resistance)	Condition of magnet.
11 11	312	off
13	317	off
15	311	off
17	345	on
19	328	off
21	306	on
23	303	off
25	293	on
27	300	off
29	290	on
31	307	off
33	283	on
35	292	off
37	288	on
39	302	off
41	292	on
43	309	off

It will be seen from this experiment that the *first effect* of putting on the magnetism was a marked increase of resistance; but with this exception the resistance, when the magnetism was on, was less than the mean of the two resistances on both sides of it, representing the magnetism off.

3. The arrangement remained untouched, as far as we know, from Dec. 15, when it was finally made, until Dec. 19, when the experiments were interrupted during the Christmas holidays; and in all cases the *first effect* of putting on the magnetism was a marked increase of resistance.

It was soon seen that this *first effect* had some reference to the time elapsing since the last experiments were made. For instance, there was on Dec. 18 a marked increase of resistance when the magnet was first put on; but on the afternoon of that day the experiments were repeated, and there was no apparent increase of resistance in this *first effect*. Next, with regard to the *average effect*; on Dec. 16, 17, and 18, this *average effect* of magnetism was a decrease of resistance.

4. The experiments were resumed on Jan. 7, the arrangement having remained untouched during the holidays. From this date until Jan. 10 inclusive, the key was taken out before beginning experiments in the morning; there was no peculiar *first effect*; while, on the other hand, an *average effect* denoting a decrease of resistance came out very prominently. On Jan. 12 and 13 the key was only taken out before magnetising, and on these occasions the *first effect* denoting increased resistance was sufficiently marked.

Our method of procedure was varied in the above manner up to Jan 27; and it was invariably found that whenever the key was taken out before commencing experiments there was no *first effect*; but when it was kept in until before magnetising, this *first effect* was sufficiently marked. These experiments concur in proving that the *first effect* has some reference to the previous treatment of the wire, but they do not prove that it is at the same time connected with the putting on of the magnetism. To determine this point we made a set of experiments on Jan. 22, 26, and 27. When the current had become constant the key was taken out, but the magnetism was not put on; and on these occasions there was no *first effect* of the current upon itself in the direction of increased resistance, but rather in the opposite direction. It thus appears that the *first effect* which increases the resistance has not only reference to the previous treatment of the wire, but depends also on the magnetism being put on.

This result is confirmed by experiments made previous to Dec. 12, in which the key was not taken out at all. For instance, we have on Dec. 9—

First off.	On: First effect.	Second off.
0	+ 54	+ 45

We have hitherto only spoken of the *first effect* obtained after Jan. 7, we now come to the *average effect*. From Jan. 7 to Jan. 27 inclusive, the magnetism was always put on in the same direction, and the *average effect* invariably denoted a decrease of resistance when the magnetism was on.

5. On Jan. 28 the magnetism was reversed; the effect during this day was very irregular. On Jan. 29, 30, 31, Feb. 2, the key was left in until before magnetisation. The *first effect* was now extremely large, but it was suspected that during these experiments the contact of the key was not very good.

On Jan. 29 the *average effect* denoted a decrease of resistance, but on Jan. 30, 31, Feb. 2, 4, 6, the *average effect* denoted an increase of resistance.

6. From Feb. 6 until Feb. 11 the wires were left broken; on Feb. 11 there was a very slight *first effect* in the direction of increased resistance, and a slight *average effect* in the direction of decreased resistance. On Feb. 12 a mercury interruptor was used instead of a metal key, both the wires being broken by it, and its use was continued until Feb. 18. The interruptor was left in over night, and the current was only broken before magnetisation, but no *first effect* was observed.

From Feb. 19 to Feb. 26 one wire only was broken by the fluid interruptor, nevertheless there was no *first effect*.

On Feb. 12, when the fluid interruptor was first employed, there was a very small *average effect* in the direction of increased resistance; but in all the experiments afterwards this *average effect* was in the direction of decreased resistance. The magnetism had been in one direction from Jan. 28, but during the experiment of Feb. 25 it was reversed and retained in this condition through the experiment of Feb. 26 without appearing to affect the results.

7. From these experiments we may perhaps conclude as follows:—

In the *first place* there is a *first effect* in the direction of increased resistance which appears to have reference to three things, namely, the previous state of the wire, the solidity of the circuit, and its magnetisation.

In the *second place* we have an *average effect*, of which the normal state appears to denote a decreased resistance while the magnetism is on, without reference to the direction of the magnetism.

In the *third place*, when in a solid circuit the direction of the magnetism has been recently changed, there appears to be a temporary reversal of the average effect, which appears at first as an increase of resistance. Besides the evidence herein detailed, we have other evidence in favour of the third conclusion; for in some preliminary experiments, in which we frequently reversed the poles, we found an increase of resistance when the magnetism was on.

We are led to conclude, from other experiments besides these, that the effect of the magnetism is not merely confined to the part of the copper wire wound round the poles, but is propagated all along the wire. On Dec. 2, for instance, the current was passed through the wire, the galvanometer being joined as a secondary circuit. The main current was therefore measured. The deflections were as follows:—

297	off	300	off
300	on	302	on
297	off	301	off
300	on		

This shows an average strengthening of the current equal to about 1-200 part of the whole. Were this strengthening due merely to the change of resistance of that part of the wire wound round the poles, the effect as measured by the much more delicate arrangement of Wheatstone's bridge would be much larger than was actually observed.

9. Allusion was made in Article 7 to some preliminary experiments in which increased resistance was observed when the magnetism was put on alternately in different directions. Similar experiments were made, giving the same result with a piece of coke and graphite which were between the poles of the magnet.

10. We have also some evidence that a copper wire, one end of which is wound round the pole of the magnet, changes its position in the electromotive series. Two copper wires were dipped into dilute nitric acid and connected with the galvanometer. A weak current passed through the galvanometer owing to a slight difference in the copper wires, one of which was also connected with the copper wire wound round the magnet. When the magnet was on, the current as a rule changed in intensity; but the effect was small, and the difficulty of having two copper wires which, when joined together and dipped into nitric acid, give a current sufficiently weak and constant, prevented us from getting any decided results.

11. In conclusion we have to state that we regard these results which we have ventured to bring before the Royal Society as preliminary, the correctness of which will, we trust, be confirmed by the further experiments which it is our intention to make.

Mathematical Society, Thursday, May 14.—Dr. Hirst, president, in the chair.—The president having vacated the chair gave an account of his paper On the correlation of two planes. "A correlation is said to be established between two planes, when their points and right lines are so associated that to each point in one of the planes, and to each line passing through that point, respectively correspond, in the other plane, *one* line and *one* point in that line." It was first shown that eight conditions are necessary and sufficient for the establishment of a correlation between two planes: and in the next place it was shown that the problem of determining a correlation between two planes which shall satisfy *any* eight given conditions is susceptible in general of a finite number of solutions. Systems of correlation were then considered: as also the origin and nature of exceptional correlations. Relations were next established between the characteristics and singularities of any system of correlations. An enumeration and classification of the fundamental systems of correlations were then made and illustrated by reference to a table in which the systems were arranged in six groups. Dr. Hirst also touched upon the number and nature of exceptional correlations in the fundamental systems. A table was exhibited showing the number of correlations satisfying eight elementary conditions. If α points in one plane have given polars in the other; β right lines in the first plane have given poles in the second; γ points and δ lines in each plane have given conjugates in the other plane, then $(\alpha\beta\gamma\delta)$ is termed the *signature* of the system of correlations satisfying the above conditions. We see that the systems of correlations corresponding to the signatures $(\alpha\beta\gamma\delta)$ and $(\beta\alpha\gamma\delta)$ are identical. The following two theorems are generalisations of the results arrived at:—(I.) In a system of correlations $(\alpha\beta\gamma\delta)$, the curve of the class $[\alpha\beta(\gamma+1)\delta]$ which represents either of two conjugate points A_1, A_2, breaks up into the other, together with a point on each of the singular lines associated with those which pass through the former. The multiplicity of A_1 on the representative of A_1 is $[(\alpha+1)\beta(\gamma-1)\delta]$, and that of A_1 on the representative of A_2 is $[\alpha(\beta+1)(\gamma-1)\delta]$. The number of singular lines which pass through A_1 is $[\alpha\beta(\gamma+1)\delta]-[(\alpha+1)\beta(\gamma-1)\delta]$, and the number of those which pass through A_2 is $[\alpha\beta(\gamma+1)\delta]-[\alpha(\beta+1)(\gamma-1)\delta]$. (II.) In a system of correlations whose signature is $(\alpha\beta\gamma\delta)$, the curve of the order $[\alpha\beta\gamma(\delta+1)]$, which represents either of two conjugate lines a_1, a_2, breaks up into the other, together with a line through each of the singular points associated with those situated on the former. The multiplicity of a_2 on the representative of a_1 is $[\alpha(\beta+1)\gamma(\delta-1)]$, and that of a_1 on the representative of a_2 is $[(\alpha+1)\beta\gamma(\delta-1)]$. The number of singular points situated on a_1 is $[\alpha\beta\gamma(\delta+1)]-[\alpha(\beta+1)\gamma(\delta-1)]$, and the number of those situated on a_2 is $[\alpha\beta\gamma(\delta+1)]-[(\alpha+1)\beta\gamma(\delta-1)]$.—Mr. Spottiswoode (the chairman *pro tem.*) and Prof. Clifford spoke on the subject of Dr. Hirst's communication.—Mr. Spottiswoode, F.R.S., next briefly stated some of the results given in his paper On the contact of quadrics with other surfaces. The following were amongst those stated:—Through any m (or $m+1$) points of space 3^{m-2} surfaces, having $2m-2$ (or $2m-1$) independent constants in their equation, can be drawn such that a quadric may be described touching any of the surfaces in the m (or in m out of the $m+1$) points. Thus for example:—the equation of a quartic scroll having a triple line is $(ax+by)zx^2+(cx+dy)wy^2-mx^2y^2=0$; hence, through any three points of space, three quartic scrolls having the same double line can be drawn such that a quadric may be described touching any one of the scrolls in the three points. Again, the equation of a quartic surface having for its nodal line the twisted cubic $p=xz-y^2=0$, $q=xw-yz=0$, $r=yw-z^2=0$, may be put in the form $ap^2+bq^2+cr^2+2(fqr+grp+hpq=0$, hence, through any four points of space, three quartics, having the same twisted cubic for their common nodal line, may be drawn such that a quadric may be described touching any one of the quartics in three of the points. Remarks were made on the paper by the president and by Prof. Clifford.—A paper by Mr. J. H. Rohrs, communicated by Prof. Cayley, was taken as read. Its subject was "The Rotation of a Hollow Sphere filled with viscous fluid and made to rotate about an axis through its centre under the action of an external impressed given periodic force."

Meteorological Society, May 20.—Dr. R. J. Mann, president, in the chair.—The following papers were read:—Some remarks on the estimation of wind force, and on the relation between pressure and velocity, by C. O. F. Cator, in which he first expressed a strong opinion on the impossibility of *estimating* the force of the wind with any degree of accuracy; but thought that for any useful purpose it must be obtained from *instrumental* observation. He then referred to the different notations for describing the wind, and condemned Beaufort's (0 – 12) as eminently unsatisfactory, both on account of the means by which the numbers were arrived at, and also especially because of the difference of standard for the lower and higher numbers. He suggested that during an observation the wind could not practically be described as an absolute force, on account of its frequent variations, but as a varying force, extending over two or three numbers; and then proceeded to account for the difference of force, as estimated, at any stations from different directions although the velocity as shown by Robinson's cups might be the same—partly by the position of the observer not being identical with that of the cups, and partly from the surrounding objects. He then suggested a new scale, and that whether pressure or velocity were the basis, it should increase in arithmetical progression, and concluded by expressing his preference for the former.—On the weather of thirteen winters, by R. Strachan.—On a new deep-sea and recording thermometer, by H. Negretti and J. W. Zambra.—On a new mercurial minimum and maximum thermometer, by S. G. Denton.

Anthropological Institute, May 26.—Prof. Busk, F.R.S., president, in the chair.—Mr. Hyde Clarke read a paper entitled "Researches in Prehistoric and Protohistoric comparative philology, mythology, and archæology, in connection with the origin of culture in America, and its propagation by the Sumerian or Akkad races." The author began with the illustrations of the common origin of culture in Asia, Africa, and America in a chronological series of the distribution of languages in the old and new worlds in the Prehistoric and Protohistoric epochs. These included the Negritos or Pygmeans, the Cannibal races, the Carib-Whydah-Aino, the Honduras African, the Khond-Wolof, the Agaw-Guarani, the Vasco-Kolaro-Leeghian, the Ugrian, the Sumerian, &c. New facts in comparative grammar were adduced, embracing the names of animals, of weapons, the series of negative terms, and the connection of philology, mythology, and archæology, with a table of convertible equivalents of primary radicals. The second part of the paper was devoted to a special consideration in detail of the community of the Aymara and Quichua of Peru, the Maya of Yucatan, and the Mexican with those of Cambodia, Pegu, and Indo-China, and of these again with the newly-deciphered Sumerian or Akkad (cuneiform) and the connection with Georgian and Etruscan. These were combined with the monuments, arts, and archæology of the respective countries. The author, referring to his identification of the languages of the Brazil with the Agaw of the Nile, and the Akkads of the Caucasus, supported the view that culture had been introduced into South America across the Pacific by Easter Island, and suggested that it was from one original source in high Asia.

PARIS

Academy of Sciences, May 25.—M. Bertrand in the chair.—The Perpetual Secretary announced the death of M. Antoine-Marie-Rémy Chazallon, correspondent for the section of geography and navigation.—The following papers were read:—Note on the movement of the conical pendulum, with consideration of the resistance of the air, by M. H. Resal.—M. P. Desains presented the continuation of his paper on solar radiation. The author has employed in these experiments a modification of Nobili and Melloni's thermo-electric apparatus.—On the transformation of iron into steel, by M. Boussingault. The author's observations and analyses tend to show that melted steels of superior quality are really iron and carbon.' As the quality improves sulphur diminishes, and they are generally free from phosphorus, while manganese and silicon rarely exceed 1-1000.—Observations on the spectrum of comets, by P. Secchi. The author has observed the spectrum of Winnecke's and Tempel's comet, and also of Coggia's. The results in the latter case point again to the existence of carbon in these remarkable bodies. In the same paper further evidence was adduced that the line 1,474 does not belong to iron; and the author communicated also an observation on the effect of atmospheric oscillation on the appearance of Jupiter's first satellite just before passing on to the planet's disc.—On the Vidal ebullioscope, by M. E. Malligand and Mlle. E. Brossard-Vidal. This instrument is for the valuation of wines, and other alcoholic liquids.—On a new mineral species from the province of Lerida, by M. X. Ducloux. The analysis agrees with the formula $Sb_2O_5 + 4CuAgCO_3$.—On the conditions of the persistence of sensibility in the peripheral extremity of sectioned nerves, by MM. Arloing and L. Tripier.—On the addition of elliptic functions, by M. E. Catalin.—M. l'Abbé Aoust presented a paper in reply to the observations made by M. Serret on his paper on the integrals of curves which have an even polar surface.—M. Ch. Bontemps communicated his third note on the motion of the air in pipes.—On the action of sulphur urea and of carbon disulphide on silver urea, by M. J. Ponomareff.—Researches on germination, by MM. P. P. Dehérain and E. Landrin. Experiments on grain have shown that no gas is so hurtful to germination as carbon dioxide.—On ammonia and ammonium phenate in the treatment of cholera and diseases produced by ferments *à propos* of serpent bites, by Dr. Déclat.

CONTENTS

PAGE
SCIENTIFIC WORTHIES, III. CHARLES ROBERT DARWIN. By Dr. ASA GRAY (*With Steel Engraving*) 79
THE AUSTRALIAN MUSEUM 81
RIBOT'S "ENGLISH PSYCHOLOGY." By DOUGLAS A. SPALDING . . . 82
OUR BOOK SHELF 83
LETTERS TO THE EDITOR:—
    Ocean Circulation.—Dr. Carpenter and Mr. Croll 83
    Proportionality of Cause and Effect.—JAMES COLLIER 84
    The Great Ice-Age.—Rev. T. G. BONNEY 85
    Photographic Irradiation.—Lord LINDSAY, F.R.S. and A. COWPER RANYARD, F.R.A.S. 85
    Uncompensated Chronometers and Photographic Irradiation.—Prof. GEORGE FORBES, F.R.S.E. 85
    The Seal Fishery.—THOS. SOUTHWELL, F.Z.S. 85
THE COMING TRANSIT OF VENUS, VII. (*With Illustration*) By Prof. GEORGE FORBES, F.R.S.E. 86
ATOMS AND MOLECULES SPECTROSCOPICALLY CONSIDERED, II. By J. NORMAN LOCKYER, F.R.S. (*With Illustration*) 89
A BOTANICO-GEOLOGICAL EXCURSION INTO THE GRAMPIANS 90
ON THE FERTILISATION OF CERTAIN LABIATÆ. By ALFRED W. BENNETT, F.L.S. *With Illustrations* 92
NOTES 93
SCIENTIFIC SERIALS 95
SOCIETIES AND ACADEMIES 96

ERRATA.—Omit "so" in p. 62, col. 2, line 22 from bottom; p. 63, col. 2, line 20 from top, for "individual" read "undivided."

THURSDAY, JUNE 11, 1874

METEOROLOGY—PRESENT AND FUTURE

METEOROLOGY has been happily divided by Dr. Balfour Stewart into two great sections, viz. physical meteorology and climatic meteorology.[*] The object of physical meteorology is to obtain a knowledge of the physics of the earth's atmosphere and surface; whereas climatic meteorology is properly the practical application of this knowledge in investigating the temperature, humidity, and movements of the air, together with the other atmospheric conditions which make up the climate of a place.

Owing to the complexity of the subject, the first step in meteorological inquiry is to lay down on the globe for each month of the year lines marking out the mean temperature, mean pressure, mean wind-direction, and mean rainfall. Roughly approximate averages are all that are required to begin with in order to mark strongly the broad features of the geographical distribution of these fundamental elements, from a knowledge of which the guiding principles of future inquiry can alone be safely obtained. Thanks chiefly to the labours of Dove, Buchan, and the Admiralties of Holland, the United States, and Great Britain, this preliminary information has been collected and placed in a handy diagrammatic form before the public; not, it is true, with the desired fulness, since considerable portions of the globe are still either not at all or very imperfectly represented. Nevertheless, enough is known to form a good basis for future action.

It is curious to note an undertone running through the works of nearly all writers on climate to the effect that if, for any place, the *mean* temperature, pressure, humidity, aqueous precipitation, and movements of the atmosphere be stated, its climate is thereby known. Nothing can be more fallacious, the truth being that such information does not enable us to define the distinctive characteristics of any climate. To do this we must have exact observations of, at least, the daily range of temperature, and humidity, the rate of movement of the wind over the place, the drying qualities of the air, the degree of cloudiness of the sky, and the manner, whether in drizzling or in heavy showers, in which the rain falls. And since the climate of a place cannot be properly defined except by comparison with the climates of other places, absolute uniformity of instruments, and their position, and in the methods of observation at different places is indispensable; for if this be not attended to, their climates cannot be compared.

Those conversant with the subject are aware how little has really been done towards making comparable and exact observations of atmospheric temperature and humidity, and wind, and towards laying down sound methods of discussing the observations so as to deduce results which will define numerically the distinctive features of climate. For instance, even as regards such striking facts as the arresting of the growth of trees, seen at so many points round the British coasts, we are not yet in a position to say whether the results be due to mechanical, chemical, or more purely climatic influences. To take a much simpler illustration, no one could venture to institute, on the basis of the temperature observations as at present made in different parts of the British Isles, a comparison of the climates of Shetland and Cornwall, Ayrshire and Kent, &c., in respect of their most essential characteristic, viz. the daily range of temperature, owing to the want of uniformity in the methods of observation.

In truth meteorology can as yet scarcely be said to have done more than collect the rough materials for future action, or rear the scaffolding for the future building. But the time has surely come when something more ought to be attempted. Researches in physical meteorology ought now to be systematically undertaken, and climatic meteorology prosecuted with more rigorously uniform methods of observation than has yet been done. We shall briefly indicate a few of the more important lines of research to be followed under these heads.

There is no question in meteorology calling so urgently for extensive, elaborate, and necessarily expensive, experiments and observations as that of the vapour of the atmosphere. Indeed, upon the right investigation and discussion of this element the great problem of weather changes depends. The vapour of the atmosphere as an absorbent and radiant of heat, and the relation of the pure gases of the atmosphere to the solar rays, are questions imperatively calling for investigation. Intimately bound up with the same inquiry is the temperature of the sky at different heights above the horizon and at different hours of the day, and the temperature of the clouds in connection with their formation and classification—all questions of the utmost importance, particularly in their bearing on the vital subject of terrestrial radiation.

Continuous observations with reference to the heating and actinic rays of the sun in order to ascertain the law of their periodicity and their relation to the sun-spot period already ascertained, and photographic and spectroscopic observations of the sun, are also clearly essential to the progress of meteorology, there being an intimate connection between sun observations on the one hand, and meteorology, as well as terrestrial magnetism, on the other. The electricity of the atmosphere also requires special and extensive investigation.

There is another large and difficult field of inquiry, which yields in practical importance to none, viz. investigations by which are sought to be attained the means of valuing scientifically the observations made at stations of the second order, to which alone we can look for carrying out the practical problems of the science in their bearings on health, agriculture, commerce, and other great national interests. Since the observations at these stations are not made by accomplished scientific men or skilled manipulators, it is indispensable that the instruments and methods of observation be of the simplest description. Only those refined methods of observation which are consistent with great simplicity are admissible for general adoption at ordinary stations. Thus observations of atmospheric temperature can be carried on at these stations with instruments and methods of observing which are strictly uniform with each other. But a question arises, how near do the results approximate to the true mean temperature of the air at the times of observation? The answer to this important question can only be obtained by special physical researches undertaken for the purpose. Again, it is highly probable that the dry and wet bulb hygrometer will, from its great simplicity and on the whole very satisfactory working, continue to be the most suitable instrument to put into the hands of ordinary observers for observations of the humidity of the atmosphere; and since the dew-point, elastic force of vapour, and humidity are not directly observed by this instrument, but are only deductions from the observations, it is most desirable that the methods of reducing the observations be the best attainable. The tables at present in use, while tolerably good for the temperatures ordinarily observed in this country, are very inaccurate for times of great drought and heat. Indeed it is essential to the development of this important branch of meteorology that the tables for the reduction of the hygrometric observations be submitted to a thorough revision, since reductions by different methods now in use give in extreme cases, from observations of the same air, dew-points differing fully 20°·0 from each other. Extensive experiments and observations are also required in order to ascertain the conditions of a good position for the anemometer, to devise some means for comparing velocity anemometers, and to determine the relation of the velocity of the wind to the pressure which it exerts. These important practical questions, of which we are at present altogether ignorant, can only be adequately investigated at an observatory devoted to researches in physical meteorology.

---

[*] NATURE, vol. i., p. 101.

In order to complete the preliminary meteorological survey of the earth's atmosphere and surface it is indispensable that measures be taken to obtain observations from the less frequented regions of the ocean, from Arctic and Antarctic regions, large portions of British America, South America, Africa, and Polynesia; as well as observations of underground temperature obtained by improved methods at greater depths and from a more extended area of the earth's surface than have hitherto been made; and observations of the temperature of lakes at the surface, at great depths, and at their outflow. Till this be done our knowledge of terrestrial physics must be very imperfect. The extent of the British dependencies, the regions into which British commerce penetrates, and the readiness British "exiles" show to forward meteorological inquiries, point out that it is mainly to Great Britain we are to look to fill up the present blanks in the meteorology of the globe.

In working out the great national question of *local climates* it is absolutely indispensable that uniformity as regards instruments and methods of observation be secured at the different stations. This many-sided problem admits of different methods of treatment according as the inquiry is directed to agriculture, commerce, public health, or any of those other interests or pursuits which are more or less influenced by weather and climate. In investigating local climate in these relations new lines of inquiry must be set on foot. The nature and importance of some of these inquiries may be illustrated by referring to two lines of research recently taken up by the Scottish Meteorological Society, and noticed in NATURE at the time. It is proposed to inquire into the influence of the sea on climate, particularly the extension inland of this influence, which has so marked an effect on animal and vegetable life and such important bearings on the national prosperity, by establishing strings of stations from different points on the coast, and extending from the sea-shore to about two miles inland. It is further proposed to investigate certain of the more important practical problems—such as the relation of wind-force to the barometric gradient—by thickly planted *storm-stations*, radiating in lines in various directions from Edinburgh.

If meteorology is to be built on the solid ground of rigorously attested facts, it is imperative that measures be taken for the prosecution of such lines of investigation as those now indicated. To those who have given any consideration to the matter it is unnecessary to add that in no other way can the meteorology of the British Isles be placed on a thoroughly sound and satisfactory footing.

With reference to the means by which these physical and climatic researches in meteorology are to be carried on, it may be suggested whether, considering the local influence and knowledge which are absolutely essential for the successful prosecution of inquiries into local climates, it would not be the best as well as most economical course for the Government to avail itself of the assistance of the Meteorological Societies. On the other hand, the physical researches we have indicated, together with storm warnings, ocean meteorology, and some other departments of climatic meteorology beyond the power of Societies, can only be undertaken by the Government. In the future development of the meteorology of the British Isles, the co-operation of the Meteorological Societies with the Central Department is necessary, each having its own separate sphere of action, and each being to a large extent dependent on the other.

RECENT FRENCH GEOLOGICAL WORKS

Principes de Géologie Transformiste. Par Gustave Dolfuss. (Paris, Savoy, 1874.)

Éléments de Géologie et de Paléontologie. Par Ch. Contjean. (Paris, Baillière et Fils.)

THESE two recent French publications connected with Geology we propose to notice briefly together. In M. Dolfuss's earnest and suggestive little book another proof is given of the way in which the views of the Evolution School are permeating the minds of the rising generation of students in every branch of Science. If we may judge of the author from a perusal of his work, he is an enthusiastic palæontologist, who, drinking at the fountains of Darwinism, seeing clearly enough the tendency of modern thought, and full of dreams about the great future of his favourite science, has with the eagerness of a neophyte rushed forward to preach the creed which he so firmly believes. Whether or not this surmise be a true one, the book has much of the earnestness, ambition, vagueness, and inexperience of an early literary venture of an aspirant to fame. The real downright earnestness of the writer is one of the best features of the book. But we imagine that this quality would not have been impaired by a little delay in publication. The historical summary shows how limited is the author's range of reading. He speaks, for example, of Hutton having attributed everything in geology to the action of fire—an utter misconception and misstatement of the doctrines of the great philosopher.

He very properly claims for Constant Prevost a high place in the list of writers by whom modern geology has been mainly influenced. Indeed the great merits of that far-seeing man are not properly understood and acknowledged even in his own country; they are almost unknown among ourselves. At the same time it is a great mistake to attribute to him, as M. Dolfuss does, the founding of the school whose leading principle is "the present the key to the past." Again Lyell's *Principles* are spoken of as having appeared in the same year (1827) with Prevost's early speculations. But the first volume of the first edition of Lyell's work was not published until 1830. While acknowledging the value of the English geologist's writings, M. Dolfuss passes a rather severe, and we think not wholly justifiable, criticism upon their style, going even so far as to say that it needs real courage to follow the author of the "Principles of Geology" through his weary digressions and diffuse detail of facts. In short, M. Dolfuss looks at the historical development of geological thought through a French pair of spectacles. And in his account of the present condition of geology, the doings of his friends in France bulk as largely as those of all the rest of the world put together. This is a very innocent vanity, especially as it is coupled with profound respect for, though inadequate knowledge of, the "opinions contemporaines à l'étranger." But it evidently deprives its author's summary of the weight which a broad and impartial review would have had.

As regards M. Dolfuss's facts, he certainly does not trouble us with any measure of that wearisome detail which he deplores in some English writers. Indeed, his references to the geological formations are so sketchy, that great portions of them might have been as well omitted. Greater development might have then been given to those whence the author can cite the largest body of evidence in favour of his views. It would have been still better, however, had he been aware of the researches made in other countries, notably in Britain, regarding the physical geography of former geological periods. He could then have filled up a good many blanks in his narrative, particularly as regards the older formations. He dwells on the artificiality of the subdivisions of the geological record, the necessity for constantly judging of their value by reference to analogous cases in operation at the present time, the value of a species in stratigraphy and in palæontology. Much of what he has to say on these subjects has long been familiar to working geologists in this country, and they will be pleased to see these sound notions gaining ground abroad, and displacing the systematic "cut and dry" measuring-rod style of subdivision and classification which looks so pretty in the pages of D'Orbigny, but which has no counterpart in nature. As a curious illustration of the want of wide reading we may notice that while discussing the nature and value of species as landmarks in the geological record the author seems unaware of Ramsay's important observations on "breaks in succession" among organic remains. We earnestly recommend him not to confine his studies to such foreign memoirs as may chance to find themselves honoured by translation into the *Revue des Cours Scientifiques*, but to seek out the original sources and learn what a vast amount of sound geological work bearing on the subject he has at heart has been accomplished in recent years outside of France, in which French geologists have taken no share, and of which it is to be suspected they remain to a large extent in wilful and perhaps happy ignorance.

Prof. Contjean's "Eléments de Géologie" is a singularly excellent work; in scope it travels over a vast range of subjects—astronomy, physical geography, meteorology, mineralogy, and other branches of Science, besides the two which specially appear on the title-page. So far as we have examined it, the book is careful, exact, and full. Prof. Contjean takes his readers first through planetary space, and having given them some notion of what it is he brings them down to Mother Earth, and proceeds to dissect her with great cleverness. At the outset he states the phenomena connected with the position of our globe as a planet, and then leads us through the physical characters of the surrounding atmosphere, the seas, and the solid crust, with its overlying plains, valleys, and mountains. Having in this way described the parts of the earth he proceeds to give a most clear and satisfactory account of the phenomena of which the earth is at present the theatre—those of the air, of water, whether solid, as snow and ice, or liquid, as rain, streams, and lakes; of the solid land, such as earthquakes and volcanoes; and, lastly, of the organic influences at work in producing changes on the earth's surface. On this solid foundation of knowledge as to what our globe is at the present time the author in the last part of his book builds his narrative of what that globe has been in past ages. He now gives a succinct and rather meagre account of rocks and minerals, followed up by a much better disquisition on sedimentation (a word, by the way which we might advantageously introduce into our English geological vocabulary). His paragraphs devoted to geological structure—faults, joints, cleavage, &c.—furnish a fresh example of how little the value of these parts of practical geology is understood abroad. What we ordinarily term stratigraphical or historical geology, that is the history of the various geological formations, occupies relatively but a small part of the book. It ought to have been fuller. The various formations for the sake of convenience might have been more sharply and clearly distinguished from each other in the printing. Above all information should have been given regarding the nature, succession, and geographical distribution of the several rocks or formations from which the story of the geological record is compiled. The palæontological *résumé* under each formation is good as far as it goes, and is well illustrated with good figures. Throughout the volume the illustrations are much above the average and have likewise the great redeeming feature of not being merely repetitions of the same old drawings which have done duty in text-books in almost every language under the sun for the last twenty or thirty years.

Prof. Contjean has produced a book which is likely to be in the highest degree useful to his countrymen. He not only gives a clear and intelligible digest of what is known regarding the several subjects on which he treats, but intersperses here and there original discussions of his own, which are full of interest, and give us a very favourable impression of his powers, both as a thinker and writer. We would especially cite his examination of M. Elie de Beaumont's theory of the elevation of mountain chains. In this country, where the theory of that distinguished French *savan* has never had any hold, it may seem superfluous now-a-days to take up time in the disproof of it. But those who know what a power Elie de Beaumont has been and still is in France, how with all his abilities and knowledge and the excellent service which he has rendered by his map and other publications, he has for many years been a kind of dark shadow on the progress of the newer geology in his country, will thank the Professor at Poitiers for taking such pains to demolish the *réseau pentagonal*.

OUR BOOK SHELF

Handbook of Natural Philosophy. By Dionysius Lardner, formerly Professor of Natural Philosophy and Astronomy in University College, London. "Hydrostatics and Pneumatics." New Edition, edited, and the greater part rewritten by Benjamin Loewy, F.R.A.S. (London: Lockwood and Co., 1874.)

DR. LARDNER'S treatise on Natural Philosophy is quite familiar to those who studied Science ten or fifteen years ago. Before Ganot and Privat-Deschanel were translated, Lardner was *the* book which everyone used. It was originally almost a translation of Pouillet's "Eléments de Physique," but was added to from time to time, and is still a valuable text-book, especially the new editions of it edited by Prof. G. C. Foster, and (as in the present instance) by Mr. Benjamin Loewy. The value of the book is indeed shown by the fact, that although first published many years ago, it is still deemed worthy of new editions, and of being edited by well-known men. The volume before us has been carefully edited, augmented to nearly twice the bulk of the former edition, and all the most recent matter has been added. The treatment is essentially experimental and elementary; a slight knowledge of mathematics is needful. It is to be regretted that Mr. Loewy has not introduced metrical weights and measures. A few omissions may be noticed: the *action latérale* of Venturi is scarcely alluded to; the theory of the trompe is omitted, as are also the hydrodynamic experiments of Plateau and Magnus, and the account of Dr. Guthrie's experiments on approach caused by vibration. But the book has in the main been carefully edited and improved.

Les explorations Sous-Marines. Par Jules Girard. (Paris: Libraire, F. Savy, 1874. London: Dulau and Co.)

NO nation surpasses the French in brilliant popular expositions of the various departments of Science. They already possess a large number of works of this kind, several of which have been translated into English, and the present work by M. Girard deserves to take its place among them as an extremely interesting and wonderfully full account of the numerous and valuable results which have of late years been obtained by deep-sea exploration. The two introductory chapters gives a rapid *résumé* of the history of deep-sea exploration, with a short description of the interior economy of the *Challenger*, and a clear and pretty full description of the various apparatus used in carrying on the explorations. The subsequent part of the work consists of four divisions, the first of which treats of the characteristics of the sea-bottom looked at in its geographical relations; the second treats of life in the depths of the sea, describing eloquently the various organisms which inhabit the ocean; the third division deals with the waters themselves, pointing out the chemical properties and the physical phenomena which take place in the midst of the ocean; in the last division an attempt is made to depict the seas of ancient geological epochs, and compare them with the discoveries which have been made by recent soundings. The author seems to have fairly mastered the literature of his subject, and has managed to write a book containing a vast deal of information conveyed in clear and eloquent language. The work is profusely illustrated with artistically executed, useful, and most attractive woodcuts. The work might well be translated into English.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Habits of various Insects

[The following letter on this subject, from Fritz Muller to Mr. Charles Darwin, F.R.S., has been forwarded to us for publication by the latter.—ED.]

I DELAYED answering your kind letter of January 1 till I should have had an opportunity of examining once more some nests of leaf-cutting ants, to which you had directed my attention. In the meantime I received Belt's "Nicaragua," which I have read with extraordinary interest, and for which I must express to you my hearty thanks.

I was much surprised to learn from Mr. Belt's book how closely the far-distant province of Chontales resembles by its vegetation and animal life our own of Sta. Catharina. I am thus enabled fully to appreciate the exactness of many of his statements; he is an excellent observer, and most of his theories are very seducing. As to leaf-cutting ants, I have always held the same view which is proposed by Mr. Belt, viz. that they feed upon the fungus growing on the leaves, they carry into their nests, though I had not yet examined their stomachs. Now I find that the contents of the stomach are colourless, showing under the microscope some minute globules, probably the spores of the fungus. I could find no trace of vegetable tissue which might have been derived from the leaves they gather; and this, I think, confirms Mr. Belt's hypothesis. Here, as in Nicaragua, the Cecropiæ are always inhabited by ants, but, I think, by only a single species. I have cut down hundreds of them and never missed the ants. I wonder that it had never occurred to me that the trees are protected by the ants; but there can be no doubt that this is really the case, for young plants of Cecropiæ, not yet inhabited by ants, are often attacked by herbivorous insects.

A few days ago I caught on the flower of a Vernonia a female moth belonging to the Glaucopidæ, of which family there are here numerous species. When I seized it by the wings nearly the whole body became suddenly enveloped in a large cloud of snow-white wool, which came out of a sort of pouch on the ventral side of the abdomen, and consisted of very thin flexuous hairs 1—2 mm. long, three, four, or five of which used to proceed from the same point. I preserved the moth alive for some time, and as often as I seized her by the wings, by inflating the abdomen, a large naked membrane became visible, and somewhat protruded behind the first (white) segment of the ventral face of the abdomen (the rest of which is black), and a little more wool appeared under the posterior margin of this segment. I am at a loss as to the meaning of this curious contrivance. There is in the males of the same family an interesting secondary sexual character; they are able to protrude from near the end of the abdomen a pair of long hollow hairy retractile filaments, which in some species exceed the whole body in length. In the beautiful *Belemnia inaurata* there is a second pair of shorter filaments which are wanting in all the other species I examined (*Eunomia eagrus*, *Euchromia jucunda*, *Agyrta cærulea*, *Eudule invaria*, *Leucopsumis* sp., *Philoros* sp., &c., the names of which I owe to the kindness of Dr. A. Gerstacker, of Berlin). In some species, most distinctly in *Belemnia inaurata*, I perceived a peculiar odour when the filaments were protruded; this, I think, may serve to allure the females, which in all our species appear to be much less numerous than the males.

I mentioned to you that with our stingless honey-bees wax is secreted on the dorsal side of the abdomen; now this is also the case with some of our solitary bees, for instance, *Anthophora fulvifrons* Sm., and with some species nearly allied to that genus. These solitary bees probably use the wax only to cement the materials with which they build their nests. Our species of Melipona and Trigona also never employ pure wax in the construction of their cells or of the large pots wherein they guard their provisions; they mix it with clay, resinous substances, &c., so that in some species wax forms hardly 10 per cent. of the material. The only case, as far as I know, in which pure wax is used, is in the construction of a tube, which *Trigona jaty* Sm. builds at the entrance of its nest.

Among European Apidæ, Apis and Bombus are the only genera which wet with honey the pollen they are collecting, and in consequence of this habit the hairs on the outside of the tibiæ of the hind-legs have disappeared. This is also the case with our Meliponæ, Trigonæ, and Euglossæ. Now Centris, Tetrapediæ, Epicharis, and some other bees, collect pollen in the same way; but notwithstanding, in some species, the hairs on the tibiæ are developed in an extraordinary degree. This seemed to me rather perplexing, till I lately observed several species of Centris and a Tetrapedia gathering sand in the large hair-brushes of the hind-tibiæ, which accounts for the conservation and excessive development of the hairs.

With one of our smallest Trigonæ (*T. mirim* n sp.), of which I have two hives in my garden, I have made a long series of observations on the construction of the combs, in which the young are raised. As in all other species the combs are horizontal and consist of a single layer of hexagonal cells, like those of wasps; but the cells are vertical. There is always in this species (other species behave differently) a set of cells constructed at the same time in the circumference of the two or three uppermost combs. When the cells are ready, they are filled with food, which the bees vomit from their mouths, the queen lays an egg into every cell and these are then immediately shut. The eggs at first lie horizontally; but in the course of the first or second day they assume a perpendicular position, with the thicker end turned upwards, dipping but slightly into the semi-fluid food. The combs are never used more than once; as soon as the young bees have left them (five to six weeks after the laying of the eggs) they are destroyed and new ones built in their place.

Once I assisted at a curious contest, which took place between the queen and the worker bees in one of my hives, and which throws some light on the intellectual faculties of these animals. A set of 47 cells had been filled, 8 on a nearly completed comb, 35 on the following, and 4 around the first cell of a new comb. When the queen had laid eggs in all the cells of the two older combs she went several times round their circumference (as she always does in order to ascertain whether she has not forgotten any cell), and then prepared to retreat into the lower part of the breeding room. But as she had overlooked the four cells of the new comb the workers ran impatiently from this part to the queen, pushing her, in an odd manner, with their heads, as they did also other workers they met with. In consequence the queen began again to go around on the two older combs, but as she did not find any cell wanting an egg she tried to descend; but everywhere she was pushed back by the workers. This contest lasted for a rather long while, till at last the queen escaped without having completed her work. Thus the workers knew how to advise the queen that something was as yet to be done, but they knew not how to show her *where* it had to be done. In the same hive there appeared to be two political parties among the workers, dissenting about the construction of the combs, one destroying what the other had begun to build; but it would require a very long and tedious exposition to give you the details of the case.

Our several species of honey-bees differ as much in their mental dispositions as they do in external appearance and size (the smallest species, called *Trigona lilliput* by my brother, is only about 2.5 mm. long). Some rush furiously out of their nest, whenever an enemy approaches it, attacking and persecuting the offender; others are very tame, and permit close observation of all their work. In one large species I could even observe with a lens the act of their sucking a solution of sugar, which I had given them, and there was no doubt that at least these bees really suck, and do not lap, like dogs or cats, as Milne Edwards, Gerstacker, and most entomologists think.

There is one species (*Trigona limao* Sm., named for my brother by Mr. Frederick Smith himself) which never appears to collect honey or pollen from flowers, on which, at least, I have never seen it. It robs other species of their provisions and sometimes takes possession of their nests, killing or expelling the owners. The hives in my garden have often been invaded, and two of them destroyed, by these robbers, and I have seen in the forest several nests, formerly inhabited by other species, occupied by them.

Together with my brother at Lippstadt I intended to publish an essay on the natural history of our stingless honey-bees, but it will probably cost some years to give a tolerably complete account of them.

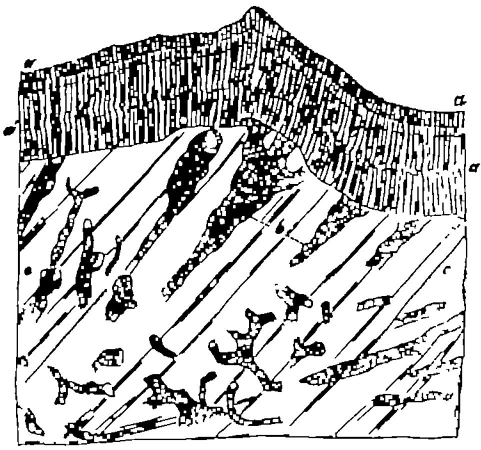
Fritz Muller

Itajahy, Santa Catharina, Brazil, April 20

Eozoön canadense

I DESIRE permission to state, in your journal, my entire agreement with the explanation of the actual structure of this fossil given by Dr. Carpenter in the Ann. Nat. Hist. for April. Though it may not be necessary to corroborate, in any way, the decisions of so great an authority on *Foraminifera*, or to add to illustrations so clear and convincing, my testimony may not be without its value; since, in addition to work in micro-geology extended over more than thirty years, and some familiarity with modern *Foraminifera*, I have, in the original examination of *Eozoon*, undertaken at the request of Sir William Logan, studied larger suites of specimens of typical *Eozoon*, and of materials supposed to resemble it, not only from Canada, but from other localities, than any other person.

I have the more pleasure in bearing testimony to the "tubulated primitive chamber-wall," because this was not manifest in my original specimens, and was first made out by Dr. Carpenter in those submitted to him from *Petite Nation* after my original description was written. I did not, however, take it for granted even on Dr. C.'s testimony, but satisfied myself of the organic nature of the structure by careful examination and comparison with the Chrysotile and other fibrous minerals occurring in connection with some of the specimens.



Part of a Calcareous lamella of *Eozoon canadense*, showing at *a a* the tubulated structure of the proper wall of the chamber or "nummuline layer," perfectly differentiated from the serpentine chamber-cast on which it abuts, and at *a' a'* a line of flexure of the tubuli, corresponding with that often seen in dentine and other tubulated calcareous structures, *b*, origins of the "canal system" in irregular lacunæ of the "intermediate skeleton" on the exterior of the proper wall of the chamber, precisely as in *Calcarina*, *c*, *c*, "intermediate skeleton," traversed by cleavage-planes, whose extension into the "nummuline layer" proves it to be a part of the calcareous, not of the serpentinous, lamella.—From a figure given by Dr. Carpenter from the Ann. Nat. Hist. for June

It is not surprising that *Eozoon* meets with some opponents. There are few naturalists who have sufficient familiarity with the structures of modern *Foraminifera*, and with those strange and gigantic representatives of the *Protozoa* found in the Primordial and Silurian rocks, to appreciate the importance of the structures it presents. Still fewer have added to this experience by the study of the structures of the fossils of the more ancient rocks as they appear under the microscope, and of the conditions of mineralisation of such fossils. The intelligent appreciation of the claims of *Eozoon* must, therefore, be of slow growth; and the controversies respecting it will be finally settled only when the other organisms of which traces exist in the Laurentian rocks are better understood, and when the *Protozoa* of the Cambrian and Silurian have been more thoroughly investigated. These desiderata are gradually being supplied; and I venture to predict that before many years have passed, palæontologists will be required to extend their belief to several other Laurentian and Primordial *Foraminifera* besides *Eozoon canadense* and *Eozoon bavaricum*.

J. W. Dawson

McGill College, Montreal, May 15

Proportionality of Cause and Effect

IT does not surprise me that Mr. Hayward gives up in despair the attempt to make Mr. Spencer conscious of the fallacies in his logic. But as from the first I have addressed myself to Mr. Spencer's readers, I must in justice to myself point out to them the true nature of the controversy in order to counteract the effect of Mr. Spencer's endeavours to represent it as a controversy between those who think that forms of thought become hereditary and those who do not. The original attack centred upon the fallacious character of certain would-be *à priori* proofs of physical laws. Mr. Spencer has tried to parry the attack by maintaining that the writer misunderstood the sense in which the phrase *à priori* was used. That the new interpretation was not the one which it was at the time intended to bear is rendered as clear as the English language permits by his speaking of one of these truths as *not* resulting "from a long registry of experiences gradually organised into an irreversible mode of thought," and his using similar, or even stronger expressions of the others. But this is, after all, not the real issue. No definition of *à priori* would cure the fallacies in the proofs in question or in the subsequent attempts that he has made to support them. They are as illogical with the one definition as with the other; and the sole result of Mr. Spencer's change of front will be, I think, to supply the critics of his writings on Physics with another instance of his habit of changing the meanings of the terms he employs without perceiving that by so doing he forfeits the right to use previous conclusions, even though legitimately obtained, and destroys all connection between the bases and the later parts of his system.

As I have already said, I have been chiefly addressing myself to Mr. Spencer's readers. My aim has been to show that his writings on Physics are marred by superficial and inconsistent views of the subject-matter and fallacies in reasoning thereon. I have been accused of being too violent in my language, and some of my friends have urged, like Mr. Hayward, that it would have been better had I used expressions which less adequately conveyed my (and their) opinion of the magnitude of the errors I was attacking. As I have left the department of personal abuse wholly to Mr. Spencer, I do not think he has much right to complain, even though I have not hesitated to call absurdities by what seemed to me descriptive and suitable titles, and I will conclude this by calling attention to a last effort by Mr. Spencer to show that there is some excuse for expressive language on my part, provided always it is directed to the blunder rather than to the blunderer.

IN NATURE, vol. ix. p. 461, Mr. Spencer asserted that the second law of motion was a mere corollary from the general postulate that cause and effect are necessarily connected together, and in all cases by definite quantitative relations. As every mathematician will at once see that there is a great difference between asserting that there is *some* definite relation between cause and effect and asserting that this relation is the *particular one* of direct proportionality, it will be asked how he came to consider the one a mere deduction from the other? It will be seen, on examination of the passage, that he is misled by a couple of instances that he cites (and of course he might have cited countless others), where there is this simple relation between a prominent part of the cause and a prominent part of the effect. The fallacy of this was pointed out by a writer who signed himself "A Senior Wrangler" in the next number of NATURE, and to this Mr. Spencer replies in the number for May 7:—

"Nor should I care to discuss any question with my new anonymous assailant, who, when certain examples given *show the 'exact quantitative relations spoken of to be those of direct proportion,'* describes me as 'intensely unmathematical,' because I subsequently use the more general expression as equivalent to the more special—which, *in the case in question*, it is."

Now, in the first place, the phrase "certain examples show," amounts to admitting that the argument is inductive in its nature, which is inconsistent, to say the least, with the professions he makes, for the proof is not only not to be an inductive one, but is to render it clear that no such proof of the matter in question could possibly exist; but this is a trifle to that which follows it. Can anyone avoid admitting that the italicised words leave Mr. Spencer committed to at least one of the following propositions:—

1. That these (and similar) instances establish the proposition that the 'exact quantitative relations' between cause and effect are, *in all cases*, those of direct proportionality.

2. That in a proof (other than an inductive one) you may assume the result during the progress of the argument without invalidating the proof.

The first of these is saved from being pronounced contrary to fact by being discovered, on closer examination, to be meaningless; nothing but the most superficial notions of the meanings of the words cause and effect can prevent its being seen to be unmeaning. The second is too common a logical error to need exposing. What examiner in Euclid has not rejected attempts at the solution of geometrical deductions for this fallacy? If a boy has to prove a triangle to be equilateral, cruel mathematicians do not allow him to assume that it is so in the course of his proof. But Mr. Spencer would take a more lenient view of the matter, and would allow him to use "the more general expression (*i.e.* triangle) as equivalent to the more special (*i.e.* equilateral triangle), which, in *the case in question*, it is."

THE AUTHOR OF THE ARTICLE ON HERBERT SPENCER
IN THE BRITISH QUARTERLY REVIEW.

MR. COLLIER, in his anxiety to "transfix" me on one of the horns of a dilemma, has shown himself strangely blind to the fact that he could only do so by thrusting at me through the body of his leader, Mr. Spencer. My wound is consequently but skin deep; but what of Mr. Spencer's?

As I have carefully avoided representing Mr. Spencer otherwise than by quoting his own words, the charge of "misrepresentation" (an ugly word, which, I think, Mr. Collier, on reconsideration, will regret having used) falls to the ground; and if, as Mr. Collier clearly enough shows, there be inconsistency in the phraseology used by Mr. Spencer at different times, the responsibility rests with Mr. Spencer and not with me.

The facts are briefly these:—Mr. Spencer first asserted the Second Law of Motion to be an "immediate *corollary of the preconception*," &c. I criticised the assertion. Mr. Spencer characterised my criticism as a proposal to "exemplify *unconsciously-formed preconceptions*." I did not care for the moment to quarrel with this description lest I should multiply and thus "confuse the issues" between us; and so adopting the phrase under the safeguard (insufficient as it now appears to have been, at least for Mr. Collier) of the usual marks of quotation, I noted what appeared to me an admission, implied in Mr. Spencer's remarks, and important as bearing on the real issue between us, that the Second Law of Motion is a "*consciously-formed hypothesis*." Mr. Collier has done well in calling attention to the discrepancy between the first two phrases italicised. He might also have noted the discrepancy between both of these and the third. But the phrases are Mr. Spencer's; and the only crime to which I can plead guilty is that of not having seen the necessity of more explicitly repudiating Mr. Spencer's characterisation of my criticism, and thus saved Mr. Collier from bringing charges against me of "confusing issues," &c., which I can only transfer to Mr. Spencer.

And now having cleared the path of the personal questions which Mr. Collier has raised, I would appeal to him to obtain for me and other perplexed readers of NATURE an authoritative statement as to what Mr. Spencer's latest views as to the Second Law of Motion are. Does Mr. Spencer regard it as an "unconsciously-formed preconception," or as a "corollary of a preconception," or as a "consciously-formed hypothesis?" Each of these views seems to be deducible from Mr. Spencer's language, but I agree with Mr. Collier that they can hardly be regarded as one and the same thing.

I would also remind Mr. Collier that no answer has yet been given to the difficulties which in my first note I showed to attach to the view of the Second Law of Motion as a "corollary of a particular preconception;" and that, unless Mr. Spencer, or Mr. Collier on his behalf, can show that these difficulties are imaginary, judgment will be recorded against them by default by all readers of NATURE who have had patience to follow the controversy thus far.

ROBT. B. HAYWARD

Harrow, June 6

I OUGHT to thank Mr. Collier for the care with which he has explained his previous letter, but to assure him at the same time that I fully understood it before; his italics have only made plain what was accurately and lucidly expressed before, and have only served to convince me that I thoroughly understand his position, and that it is wholly untenable.

I will make one more effort to show this, by pointing out one of the fallacies in Mr. Collier's last letter. He says "Mr. Spencer alleges that this cognition of proportionality is *à priori*; his opponents affirm that this cognition is *à posteriori*."

The "cognition" spoken of is not one, but two. Mr. Spencer alleges that a conviction of a quantitative relation of some kind between cause and effect, such that the greater cause produces the greater effect, grows in our minds from experiences which are antecedent to reasoning. No one denies it. But to call this a cognition of *proportionality* is so utterly inaccurate an expression as to astound me. And the consequences of the inaccuracy are immediate and evident; it is believed that special cases of proportionality are involved in the general relation, and hence that Newton's Second Law is an *à priori* cognition.

But the cognition which his opponents affirm is a very different cognition, though this is an odd name to give to a mathematical doctrine. What his opponents affirm is that in certain cases forces measured in a certain way are proportional to their effects measured in a certain way; and by proportional they mean proportional and not something else. They affirm that experiment and observation are necessary to ascertain this proportionality; and that experiment and observation, and the method of verification, furnish overwhelming evidence in favour of the truth of Newton's laws. Their best proof is the *Nautical Almanac*, to those who can understand it and them.

I believe the *à priori* method to be as utterly barren in the future as it has been in the past. When a new truth has been discovered it is easy to say that it is evident *à priori*. Some day the laws of the actions of molecules and their relations to heat and electricity will be discovered by physicists; but I imagine they will be physicists of the type of Rumford and Faraday and Thomson and Maxwell. Meantime it is open to any *à priori* philosopher to anticipate the future.

And now, as far as I am concerned, this correspondence will cease. Mr. Collier is polite enough to say that my letter would have confirmed Sir W. Hamilton in his conviction that the narrow discipline of mathematics produces an incapacity for general reasoning; and he therefore cannot be anxious to continue a correspondence with one so contemptible, so stupid, and so ignorant as he plainly believes me to be.

A SENIOR WRANGLER

I SHALL be obliged if you will permit me to correct a verbal error, of some importance, in my letter (NATURE, vol. x. p. 84). The words "*finished conception*," in col. 2, line 26, should be "*finished pre-conception*." J. COLLIER

The Glacial Period

BOTH Mr. Belt and Mr. Bonney, have, I think, missed the one point on which the question under discussion turns. The shell-bearing drift-gravels are *well stratified*. I can speak to those in the neighbourhood of Macclesfield, which run up to 1,100 ft. above the sea, being also very delicately current-laminated. I am puzzled to imagine how this structure could be obtained if the gravels were brought to their present position in the way Mr. Belt supposes; indeed its presence seems to me fatal to his hypothesis. It is not the case moreover that all the shells are smashed and scratched. At Macclesfield most of the shells are broken, as one would expect to be the case if they had been tossed about on a shingle-beach; but entire specimens were not very rare. As for scratches, I never saw one on either the shells or the pebbles of these gravels; in the boulder clay, where the included stones are scratched, scratches are occasionally seen on the shells as well. A. H. GREEN

Cockermouth, June 6

VENUS'S FLY-TRAP (*Dionœa muscipula*) *.

THERE are two ways of studying a plant or an animal. One of these consists in the mere contemplation and description of its external aspects and behaviour. Persons who occupy themselves with this sort of study are commonly called naturalists; for it is by them that by far the greater proportion of the facts we possess relating to natural objects has been gained.

But there is another and a much better sense in which a man may be said to be a naturalist. The true naturalist does not content himself with standing at one side and watching the proceedings of nature as a mere spectator. Animated by that insatiable scientific curiosity from which some shrink, in the fear lest it should carry them too far, while the greater part are indifferent, he occupies his whole life in seeking to lift the veil from all that is hidden in nature and in discovering and exposing the springs of every secret process. His restless spirit cannot content itself with contemplation of the mere external aspects of living beings nor even with the most minute and searching study of the forms and structure of organic life. For even if he begin as a botanist or zoographist, a mere describer of plants or animals, he is forced by the perception of that general adaptation of means to ends and ends to means which he sees everywhere, to become first an anatomist then a physiologist. The study of these external aspects leads him, if possessed of that curiosity which is his characteristic attribute, to study their minute structure, and this, the further he goes into it, stirs up in him the desire to penetrate further into the mysteries of their being. For the delight and interest with which the forms, colours, and structure of animals and plants fill us is derived from the conscious or unconscious perception by our minds of their *adaptation*—their fitness for the place they are intended to occupy. I would go further even than this, and maintain that our artistic perception of beauty in nature is, I believe, in great measure derived from the same source.

But to understand nature in the sense of the naturalist we must know not only those aspects which she is willing to present to us but those she is determined to hide. For this end, when we cannot get at what we want by persuasion, we are often obliged to use compulsion.

It is constantly happening to the naturalist, that he has a process, a contrivance before him, a series of phenomena the connection or evolution of which he cannot understand. He stands at one side and watches and learns but little, for nature refuses to tell *why* she does this, or *how* that. Under these circumstances, which recur, not once in a way, but daily and hourly in the study of plant and animal life, what is he to do? Is it his duty to sit down respectfully and wait, in the hope that what is now difficult and obscure may, by the light thrown upon it from right or left, become more or less clear and intelligible? No. This is not the spirit of the naturalist. If nature conceals the truth, we frankly deny her right to do so, and wrest it from her by force. If circumstances are unfavourable, we alter them to suit our ends. If, as repeatedly happens, a number of antecedents are seen to lead to one event, if a number of apparent causes conspire to one result, we proceed in our investigation by taking away first one, then others of these antecedents, until by a succession of trials (or as they are commonly called experiments) we find the true one, viz. that of which the removal or modification abolishes or alters the event. It is thus, and thus alone, that we compel nature to tell "that wherein her great strength lies."

It is my purpose in this lecture to illustrate to you if I can, by an example, that the systematic application of the method of experiment is the only method by which it is possible to become so acquainted with the forces of nature as eventually to be able to convert them to useful purposes (and this is one, though by no means the highest, end of natural knowledge). More particularly is it true of that branch of natural knowledge which *par excellence* we call physiology, that it is by experiment alone that progress has been or can be made; the whole subject being in its present state but a system of experimental results.

A while ago I applied the term forcible to this method because it is the plan by which, as Bacon said, we torture nature. But let us remember that this is a mere figure of speech. In disciplining nature to our ends, in forcing her to give up her secrets, we use no violence, but utmost gentleness. Plant or animal, to be made to tell its story, must be delicately handled, so delicately that, by association, the very care which the naturalist, for scientific ends, bestows on animals and plants, unavoidably engenders a love for them. However right and necessary it may be that we should to-night destroy and mangle these beautiful leaves for our own pleasure and instruction, let us not do so recklessly, for the life and beauty we destroy we cannot with all our science bring back again or imitate.

The name *Dionœa muscipula* was given to the plant when it was first imported from America. It belongs to the family Droseraceæ, a very natural one, *i.e.* one in which the family characteristics are so well marked that in no individual member of it can the signs of original relationship be mistaken.

---

* Lecture by Dr. Burdon Sanderson, F.R.S., at the Royal Institution, Friday evening, June 5, 1874.

In speaking of original relationship, I refer rather to that of descent or ancestry than to community of parentage. Thus in this order we have distinct evidence that in the Drosophyllums, Droseras, Dionæas, which constitute the family, the peculiarities which they have in common and by which they are distinguished from other plants are not possessed by them in equal development and completeness, so that here as elsewhere the more developed forms stand to the less perfect ones rather in the relation of descendants than in that of cousins.

In the Droseraceæ the most striking peculiarity is one which is entirely functional or even teleological. It consists in this, that each member of it possesses in one way or other adaptedness to one and the same end. This end is the catching of insects, and not only catching them but digesting them, using them as food in short, just as animals do. These animal endowments, which have for some years engaged the attention of our great naturalist, are possessed (as we hope he will some day show us) by each individual species in a degree which, in the main, corresponds to the general development of the plant; so that each advance from less to more perfect form and structure is accompanied by an improvement in its adaptedness to the function of preying upon insects.

Description of the Plant.—Of root and flowers I need say little or nothing. It is the leaf to which I have to ask your attention. It is of very peculiar form. The blade of the leaf consists of two nearly semicircular halves or lobes, which are united together along their straight borders by a strong mid-rib. On to this the two lobes are set in planes which are nearly at right angles to each other. The curved outer edge of each lobe is strengthened by a thickened border or hem. From the hem spring some twenty spikes on either side, which are directed upwards and inwards. The under surface is bright green, smooth and glistening, and is marked with parallel streaks. The upper surface is pink or red, and is beset with little red projections, which are called glands.

In addition to these glands there are on the upper surface of each lobe of the leaf three spines, which are of extreme delicacy and are always arranged as if at the angles of a triangle, about the middle of the lobe. The petiole or leaf-stalk is of the shape of the handle of a tea-spoon, the only difference being that its upper surface is channelled along the middle instead of being flat. At its end it is united to the leaf by a jointed isthmus, of about a line in length and breadth.

The mechanism by which the leaf catches insects is strikingly like that of a rat trap. When it is open the lobes are, as I have said, at right angles to each other. When an insect comes into contact with either, at once they approach each other, but this does not occur with the suddenness and completeness that it occurs in the rat trap. The lobes begin to close sharply enough, but do not come quite together, remaining for some time *entr'ouvert*. When the leaf is in this state of half closure, it is easy to see what is the significance of the two sets of prongs already mentioned. You see that they are set on alternately along the opposite edges of the lobes, so that just like the teeth of the rat trap they fit into each other. It is not difficult to see why this is, *i.e.* why the spikes are arranged alternately. The leaf, being a trap, is made like a trap. But I should not have been able to tell you why the leaf does not at once close on its prey had not Mr. Darwin told me. After having partially closed, as I have said, one of two things may happen. The insect, having been caught, at once begins to think of escaping, and makes efforts to do so, which may or may not be successful. If it is small, it easily finds its way out through this wonderful grating formed by the crossing of the teeth; and in this case the leaf soon recovers, expands again, and is ready for the capture of another victim. If it is large all its efforts to regain its liberty are futile. Repelled by its prison bars, it is driven back upon the sensitive hairs, which stick into the interior of its cell, and again irritates them. By doing so, it occasions a second and more vigorous contraction of the lobes. The result is that the creature is not only captured, but crushed; not only swallowed, but, as I have already said, digested.

In all this we see a wonderful completeness of adaptation for a purpose; but I fancy that the purpose itself would be considered unworthy or even immoral by some persons. Just as in the "gentle craft" the small fry are rejected and thrown back again into the water to enjoy a little more life and to be better prepared for their future destiny, so the plant, not quite for the same reason, acts in a similar manner. The angler rejects the small fish with a view to their future and his own, for he wants them to grow larger that he may have the better sport out of them afterwards; but the plant lets the little insects go, because it would cost too much to keep them; and this leads me to the description of what happens to the leaf and to the poor fly when it is big enough for the leaf to find it worth while capturing, *i.e.* when it is too big to slip through the bars.

Digestion of Dionæa.—Even after slight irritation, such as that which is produced when a fly merely touches one of the sensitive hairs, or when they are touched with a dry camel-hair pencil, the leaf remains closed for some time, usually more than twenty-four hours. But if a fly is caught, or any other nutritious substance is introduced, the case is different. For a week or more the leaf remains closed on its prey, the two lobes being at first pressed flat against each other. The two lobes indeed close round the fly so completely that its body gives rise to two projections of the (outer) surface of each lobe, which correspond to it in form. The result of this is that the secreting glands on the part of the leaf against which the body of the fly presses are irritated, and begin to pour out a quantity of secretion. Gradually this effect extends to the rest of the leaf, and consequently its cavity becomes gradually extended.

The meaning of this bulging is that the fly is becoming digested. The liquid juice which the glands pour out has the property of so acting on the tissue of the fly's body that they at first become diffluent and then are absorbed.

When we call this process "digestion" we have a definite meaning. We mean that it is of the same nature as that by which we ourselves, and the higher animals in general, convert the food they have swallowed into a form and condition suitable to be absorbed, and thus available for the maintenance of bodily life.

The nature of animal digestion is best explained by examples. If I take some starch, which is not soluble, and put it into my mouth, and keep it there for a certain time, it has become first soluble, and finally transformed into a substance quite different in properties. If we examine into this process we find that the change of starch into sugar takes place, because there exists in saliva a ferment called ptyaline. We know that it is the ptyaline which does the work, because if we separate this substance in a solid state, then dissolve it in water in which starch is diffused, the starch is converted into sugar. We call it a ferment, for two reasons—first, because, like leaven, it acts in small quantity, a mere trace being sufficient; and secondly, because it does not itself take part in the transformation. This is one example, and a very simple one; but it is not with this that we compare the digestion of Dionæa, but with that which in man and animals we call digestion proper, the process by which the nitrogenous constituents of food are rendered fit for absorption. This takes place, not in the mouth, but in the stomach. It also is a fermentation, *i.e.* a chemical change effected by the agency of a leaven or ferment which is contained in the stomach-juice, and can be, like the ferment of saliva, easily separated and prepared. As so separated, it is called pepsin (the medicine called by that name is supposed to contain some of it, and indeed often does). Consequently, having the ferment, we can easily imitate digestion out of the body. For this experiment there are three things necessary—first, that our liquid should contain pepsin; secondly, that it should be slightly acid; and thirdly, that it should be kept at the temperature of incubation, *i.e.* about 97° F. We select for the experiment a substance which, although nutritious and containing nitrogen, is not easily digested—such, for example, as boiled white of egg. In water containing a small percentage of hydrochloric acid and a trace of pepsin, it is gradually dissolved; but chemical examination of the liquid shows us that it has not been destroyed, but merely transformed into a new substance, called peptone, which is afterwards absorbed, *i.e.* taken into the circulating blood.

Between this process and the digestion of the Dionæa leaf, the resemblance, as Mr. Darwin has found by a most elaborate comparative investigation, is complete. It digests exactly the same substances in exactly the same way, *i.e.* it digests the albuminous constituents of the bodies of animals just as we digest them. In both instances it is essential that the body to be digested should be steeped in a liquid, which in Dionæa is secreted by the red glands on the upper surface of the leaf; in the other case, by the glands of the mucous membrane. In both the act of secretion is excited by the presence of the substance to be digested. In the leaf, just as in the stomach, the secretion is not poured out unless there is something nutritious contained in it for it to act upon, and finally in both cases the secretion is acid. As regards the stomach, we know what the acid is: it is hydrochloric acid. As regards the leaf, we do not know precisely as yet, but Mr. Darwin has been able to arrive at very probable conclusions, the setting forth of which we look forward to in his expected work on the Droseraceæ.

(*To be continued.*)

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"[*]

IV.

IN the Teleostei the jaws attain their maximum amount of mobility, and the articulation of the lower jaw is, consequently, brought to the farthest possible distance from the skull, by the disjointing of the mandibular arch from its original attachment. This arch consists of two cartilaginous bars (see Fig. 11, PLPt and Mck) corresponding to the upper and lower jaws of the shark or ray, but containing certain important ossifications. The apex of the arch, corresponding to the spiracular cartilage of the ray, is formed by the meta-pterygoid (Fig. 7, M.Pt), below which, and separated from it by a broad synchondrosis, is the quadrate (Qu) bearing a rounded articular surface for the mandible. In the pterygo-palatine cartilage are three ossifications—the palatine (Pl), pterygoid (hidden in the figure by the maxilla and jugal), and mesopterygoid (Ms Pt). The proximal portion of the originally cartilaginous lower jaw is ossified by the articular (Art), while its distal portion remains as the comparatively slender Meckel's cartilage, running on the inner side of the dentary, almost to the symphysis.

As in the Elamobranchs, the proximal part of the hyoid arch forms the suspensory apparatus for the jaws, but unlike the corresponding cartilage in those fish, contains two ossifications, the large and massive hyo-mandibular (H.M), articulating with a cartilaginous surface afforded to it by the sphenotic and pterotic (see Fig. 9), and the symplectic (Sy) below, which, fitting into a groove in the quadrate, firmly binds together the hyoid and mandibular arches. The free portion of the hyoid articulates with the cartilaginous space between the hyo-mandibular and symplectic, through the intermediation of a small bone (shown in Fig. 7 by dotted lines, being hidden by the pre-opercular), called by Cuvier the stylo-hyal, but better named inter-hyal, as it is not the homologue of the mammalian styloid process. The hyoid cornu is segmented as in the ray, except for the fact that there is a median basal piece, usually called, from the circumstance of its giving support to the tongue, glosso-hyal (G.Hy). All these segments are ossified and separated from one another by tracts of cartilage.

The branchial arches are much smaller in proportion to the mandibular and hyoid than in the shark and ray; they also lie almost entirely within the latter, instead of in a regular series behind it. Each of the first four bars is divided into pharyngo-, epi-, cerato-, hypo-, and basi-branchial; and each segment, with the exception of the last pharyngo-branchial, is ossified. The fifth arch (inferior pharyngeal bone) is much smaller than its predecessors, and consists simply of a tooth-bearing cerato-branchial. The pharyngo-branchials (superior pharyngeal bones) are not dentigerous.

The development of the salmon was described at far greater length than that of the shark or ray, the metamorphoses gone through being much more complex, and exhibiting in a most instructive manner the endless modifications which the facial arches may undergo in their modes of segmentation and coalescence.

Besides the adult, seven arbitrary stages of the skull were described; in the first three of which the embryo was still unhatched, and lying as a flat tape-like band about [illegible] of an inch long coiled round the yelk-sac; in the fourth the head was just emerging from the chorion; the fifth consisted of salmon fry at the second week after hatching; those of the sixth stage were at the sixth week; and those of the seventh young salmon of the first summer, varying in length from $1\frac{1}{2}$ to $2\frac{1}{4}$ inches, and having in all essential respects the cranial characters of the adult. The earliest stages are remarkable for their want of symmetry, the head being so twisted that only one eye is visible in an upper view.

The head of an embryo at the first of these stages is shown in Fig. 10; it resembles very closely the earliest conditions in the shark and ray (Figs. 3 and 6, vol. ix. p. 467), having, like them, prominent sense-capsules, a widely-open mouth, and simple, unsegmented facial arches, which latter, however, present very important differences to the homologous structures in the lower types. The trabeculæ (Tr) are seen in the roof of the mouth, where they lie, enclosing the pituitary body (Pty) like a pair of forceps, in the same plane as the investing mass and notochord, and not at right angles to them like the post-oral arches. Curving under the eye is a bar of somewhat thickened indifferent tissue (PLPt) representing the pterygo-palatine arcade, but, even in this extremely early stage, so entirely distinct from the mandibular arch proper (Mn) as to have the appearance of a true, separate face-bar. It long remains, however, in a rudimentary state as regards histological development, not being converted into true hyaline cartilage until the fourth stage, when it unites with the main part of the mandibular arch.

In the second stage, a most noticeable change has taken place with regard to the hyoid. A lozenge-shaped basal piece, the glosso-hyal, has appeared between the bars of opposite sides, and the whole arch has split lengthwise from top to bottom, becoming divided into an anterior and posterior division, the former of which becomes the fixed hyo-mandibular and symplectic, the latter the free epi- and cerato-hyals.

In the third stage, this process has gone farther; the two divisions of the hyoid have become separated from one another below, and have grafted themselves above to the auditory capsule, thus approximating very closely to the state of things found in the ray, where, as in this early stage of the salmon, the two parts of the hyoid are nearly equal in size. The pterygo-palatine has not yet united to the mandibular arch, although it has joined anteriorly with a "conjugational process" sent out from the now flattened trabecula. Meckel's cartilage is entirely separated from the quadrate.

---

[*] Continued from p. 10.

The chief point to be noted in the fourth stage is the assumption of an undoubted Teleostean character, by the slipping down of the posterior bar of the hyoid, which is now attached, not to the upper angle of the anterior bar, but to about its middle, a small nodule of cartilage, the inter-hyal, appearing between the two. This important change has advanced still farther in the fifth stage (Fig. 11), in which also the palato-pterygoid has united with the quadrate, and the membranous roof of the brain-case, beginning to chondrify, has formed the anterior part of the tegmen cranii (T.Cr), and sent back a supra-orbital bar (S.Or) to meet the ear capsule, leaving, however, a large membranous space or fontanelle (Fo) in the roof of the cranium. The trabeculæ, although flattened out and united in front, are completely separated behind, both from one another and from the investing mass, which is merely overlapped by their slender inturned posterior ends (pharyngo-trabeculars). The jaws are constituted exclusively by the palato-pterygoid and Meckelian cartilages, and in many other points the skull now bears a very close resemblance to that of the shark or ray, and still more to that of certain recent Ganoids, such as Polypterus.

Fig 10.

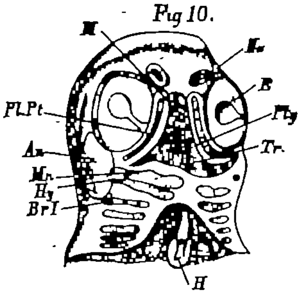


Fig. 10.—Head of Embryo Salmon, about ½ inch long (× 10 diam.). H, heart.

Fig. 11.

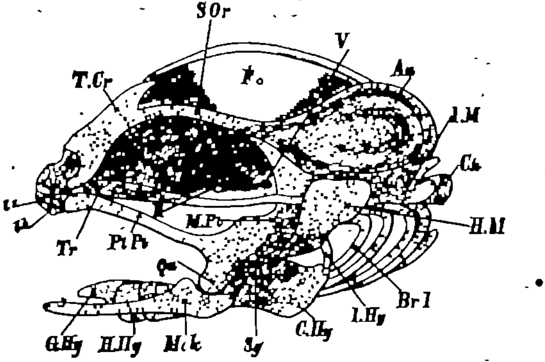


Fig 11.—Skull of Young Salmon, the second week after hatching. (× 12 diam.) Fo, fontanelle, I Hy, inter-hyal.

The sixth stage shows ossification to have set in at several points, and exhibits in an interesting manner the formation of the inter-orbital septum. The cartilage between the nasal sacs (mesethmoid) has sent backwards a triangular plate towards the orbito-sphenoidal region, another plate has risen up from the middle line of the skull-floor or coalesced trabeculæ; and by the subsequent union of these two elements the partition so characteristic of bony fishes, as well as of reptiles and birds, is produced. It is the fissure left by the incomplete union of these elements which is shown at e.t.f in Fig 8 (p. 10). In the seventh stage all the ossifications have appeared, and the skull is fast taking on adult characters.

V. *Skull of the Axolotl* (Siredon pisciforme). The group of tailed Amphibia or Saurobratrachia is one of the most interesting in a craniological point of view, presenting, as it does, so great a variety of types, that while the highest, such as the salamander, approach nearly to the frogs and toads, the lowest, such as Proteus and Menobranchus, have a chondro-cranium actually lower than that of the lamprey. As a rule, indeed, the skulls of those Saurobratrachia which, like the Axolotl and the two genera mentioned above, retain their gills throughout life, have, when once the investing bones are removed, a simpler and more embryonic structure than that of any other adult animal.

The two chief roofing-bones of the brain-case—the parietals and frontals—are far more normal in their relative size than in the salmon, the parietals uniting in the mid-line, and sending off an unusually long anterior process to the ethmoidal region. The nasals are separated from one another by the long ascending processes of the pre-maxilla: the supra-ethmoid of the salmon is absent, but the lateral ethmoid is represented by a membrane-bone (Fig. 12, L.Eth) evidently corresponding with the pre-frontal of reptiles, which overlies the cartilage behind the nasal sac and extends backwards to meet the anterior process of the parietal. The maxilla is considerably smaller than the pre-maxilla, and is free behind, there being no jugal or quadrato-jugal to unite it with the quadrate. On the under-surface of the skull is the large oblong para-sphenoid, and in front of it, bounding the inner side of the posterior nares, the well-developed tooth-bearing vomers, which together represent the single bone of that name in the salmon. All the opercular bones of the fish are absent, except the pre-opercular, now, as in all the high vertebrata, known as the squamosal (Sq), a flat ossification clamping the suspensory apparatus of the jaw, and extending upwards and backwards to the auditory region.

Fig. 12.

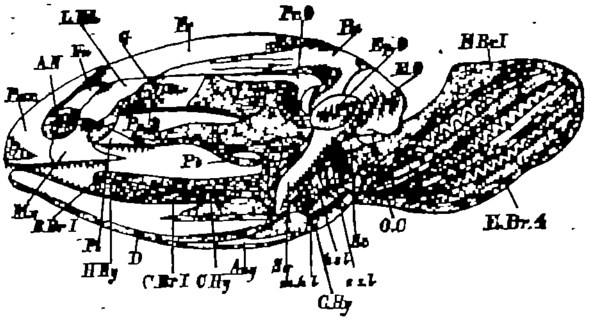


Fig. 12—Skull of nearly adult Axolotl (× 2 diam.) A N, anterior nares, s s l, stapedio-suspensorial ligament, h s l, hyo-suspensorial ligament, m h l, mandibulo-hyoid ligament, St, stapes; G, girdle-bone, Sq, squamosal.

In the mandible three membrane-bones are developed, the two first of which bear teeth; the dentary has the same relations as in the salmon, the splenial lies as a flat splint on the inner side of each ramus, and the angular is also chiefly visible within, a small portion of it only (Ang) being seen externally.

The remaining bones will be described with the chondrocranium, of which they are ossifications.

(*To be continued.*)

ON SPECTRUM PHOTOGRAPHY[*]

THOSE of you who know best how the Society of Arts always places itself in the forefront of any movement which is likely to benefit mankind by the application of the various sciences to the practical affairs of life, may recollect that, as nearly as may be thirty years ago, the dawn of a new science was brought before an audience in this room. If I look, no longer to the Journal, but to the "Transactions," of the Society of Arts, Manufactures, and Commerce, as far back as the year 1843,[†] I find a paper there by the late Mr. Claudet, who then gave an account of the progress which had been made up to that time in an art and a science which is now pefectly familiar to all of you; I refer to photography. It is exceedingly curious that his lecture on the origin of this science, and my present lecture on the application of photography to spectrum analysis are complementary to each other, so much so that one may almost say that Mr. Claudet's lecture, admirable though it was, was incomplete, because he did not show in it, as of course he could not, how certain matters which he referred to in that lecture have been dealt with in the light of modern science.

If you carry yourselves back to the year 1839, some four years before the lecture to which I refer was delivered, you will recollect Mr. Nièpce had at that time brought photography to a more practical realisation than it had been by any of his predecessors. He had then for some years allied himself with Daguerre, and the daguerrotype was already in existence. The action of iodine on silver, first discovered by Fox Talbot, had been fixed by the vapour of mercury.[‡] Now, in the daguerrotype we had not the action of light in its ordinary sense; and men's minds were very much exercised as to what could be the real cause of the effects which were then being revealed. Mr. Claudet, in his lecture, points this out in a most admirable way, and I will summarise, if you will allow me, some of the principal points to which he alludes. You had a beam of light falling on a plate. On this plate was a certain chemical compound. What part of the sunlight, or was it sunlight at all, which so acted upon this compound, that you got an image more or less permanent? What more natural than that this question should be investigated by means of various tinted glasses? The solar beam which the experimenters then used they made to pass through glass, now of one colour, and now of another. I can show you, by means of this electric lamp, nearly what they did. Imagine the lamp to be the sun; in the path of the beam differently coloured glasses are placed. We have now the action of a red glass; we now change the red glass for another one, and now we have the action of a green glass. There was an immense deal of difference of opinion concerning the action of light as investigated in this way. In fact, I shall have shortly to show that Mr. Claudet and a very distinguished French physicist, M. Becquerel, were considerably at variance with regard to one particular point which came out from this kind of investigation. But we had not long to wait. Sir J. Herschel, in the year 1839, pointed out that it was not a question of investigating these new qualities of light at all by means of coloured glasses; they should be investigated by means of the spectrum. In three papers, communicated to the Royal Society in the years 1839, 1840, and 1842, he showed that the only philosophic way of investigating this problem was really by obtaining a pure spectrum, such a one as I now throw upon the screen. You see that we have, at once, in different parts of this spectrum, exactly what we get at different times when we deal with red glass, yellow glass, orange glass, green glass, blue glass, and so on. And having such a spectrum as this to deal with, and supposing such a spectrum thrown on to the photographic plate, it is quite clear to all of you that if there were something magical or unknown in the red rays which gave us this new action on the molecules of the particular chemical compound employed, or whether this magic really resided in the blue rays, that we should at once have this pointed out to us in the most unmistakeable manner, by action in the part of the plate on which the red rays fell, or in the part of the plate on which the blue rays fell.

Now, although Sir John Herschel was the first, in this country, to point out the extreme importance of this point of view, he was by no means the only one. Then, as now, there were distinguished Americans who were well to the front, and among them was Dr. Draper, the father of another Dr. Draper whom I shall have to speak of by and by. Those of you who are familiar with the enormous step in advance which was taken in spectroscopic investigations by Wollaston, who substituted a slit for a round hole, will perhaps be somewhat surprised to find that the first observations were conducted by throwing a converging beam of sunlight, giving an achromatic image of the sun, on the plate, through a prism. This method of procedure of course did not go so far as a better one might have gone, but it went a considerable way. Sir J. Herschel, from his observations made in this manner, stated that he had found a new kind of light—a new prismatic colour, "lavender grey," altogether beyond the blue end of the spectrum, such as you have seen it on the screen —altogether beyond the *blue* end of the spectrum, not the *red* end. Prof. Draper, on his part, also came in the main to the same conclusion, stating that he had discovered a "latent light."

When we have come from the year 1839 to the years 1842 and 1843, we find a great advance—an advance, just the same as far as photography goes, as Wollaston's advance on Newton was with regard to spectroscopic observation. Both Becquerel and Draper introduced, instead of this achromatic image of the sun, the simple arrangement of throwing sunlight through a slit and a proper combination of lenses on to a plate. The result was that on June 13, 1842, Becquerel did what I may venture to call a stupendous feat.[*] He did what has never been done since, so far as I know. He photographed the whole solar spectrum with nearly all the lines registered by the hand and eye of Fraunhofer. I do not mean merely the blue end of the spectrum, as you may imagine, but the complete spectrum, from the "latent light"—the ultra-violet rays of Draper—to the extreme red end. Draper also did something like the same thing, but not quite the same thing, in what he calls a "tithonographic representation" of the solar spectrum. He gives certain lines in the extreme visible blue part of the spectrum,[§] certain other lines, which none but Becquerel had ever seen before (Draper's work being done nearly a year later), and in the extreme red—beyond the visible red of the spectrum—he gives other lines which even Becquerel had not photographed. This of course was such a tremendous revelation to both these men that as you can imagine a considerable discussion arose. Becquerel found, from an absolute comparison between the Fraunhofer lines which he had photographed and the Fraunhofer lines which Fraunhofer himself had registered, evidence in favour of the fact that this new chemical agent which was astonishing the world, whatever it was, was not something absolutely and completely independent of the visible rays. Draper, on the other hand, in his "tithonographic representation," had, for some photographic reason or other, not succeeded in registering the lines in the yellow, orange, and green part of the spectrum, although he had fixed the lines in the blue, in the extreme violet, and in the extreme red; and he considered himself justified by his experiments in coming to exactly the opposite conclusion to that at which Becquerel had arrived, namely, that the light, whatever kind of light it might be, which was at work in effecting this chemical change which rendered photography possible, was something absolutely and completely independent of the ordinary light which the retina receives.

This was in the year 1843. I need not tell you that by the year 1845, in which year Mr. Claudet read another paper before this Society, further investigations by means of the spectrum had

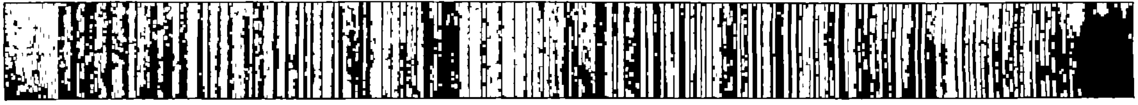


FIG. 1.—Reduced copy of Becquerel's photograph of the complete solar spectrum taken in 1842.

---

[*] A Cantor Lecture delivered at the Society of Arts, Nov 24, 1873, by J Norman Lockyer, F.R S.

[†] Vol. iv p 89.

[‡] Fox Talbot, *Philosophical Magazine*, vol xxii. p, 97.

[§] *Philosophical Magazine*, vol. xxii p. 360, 1843. For his earliest work see Journal of the Franklin Institute for the year 1837.

[*] "Bibliothèque universelle de Genève," t xxxix.-xl., 1842, p. 341.]

shown that Dr. Draper's idea was heretical, and at the present moment you know it is the general opinion of physicists, an opinion founded upon the work which has been done to advance photography, and other researches since that time, that the radiations which you get from any light source, from the extreme violet to the extreme red, differ only in the rate and in the magnitude of the vibrations which are at work, so that I claim for the application of photography to spectroscopy, as a first result, the establishment of a great fact, that the visible, the chemical, and the heat rays are really part and parcel of the same thing, that thing being a system of undulations varying in rate and wave-length from one end of the spectrum to the other, whether you consider the visible portion or the invisible rays—those outside the blue in one case, and outside the red in the other. But this is not all: I claim another thing for the application of photography to spectroscopy. Sir J. Herschel, so soon as he applied the prism, stated, in a communication to the Royal Society, that it was no longer possible to proceed with that branch of research under the best possible conditions, unless opticians would construct lenses which would bring the visible and the chemical rays into absolute coincidence. This is now done by our Rosses and Dallmeyers in the camera-lenses, and that is the second great feature which I claim for the application of photography to spectroscopy.

The next step brings us down to the year 1852. In this year a paper† was communicated to the Royal Society, by Prof. Stokes, who had already announced his discovery of what has since been called "fluorescence;" "on the long spectrum of the electric light." Prof. Stokes dealt in his first paper with the "change of refrangibility," or, as Sir William Thomson proposed to call it, "degradation of light," by virtue of which, light, which was generally invisible to us, could, under certain circumstances, be made visible.* It is no part of my present purpose to go into this magnificent paper, one of the crowning glories of the work of this century, at any great length; but you will see in a moment that, if it were a question of the *degradation* of light, then the invisible light to which Prof. Stokes referred as being capable of being rendered visible, must have been light outside the blue end of the spectrum, and not outside the red. Prof. Stokes, in his investigations, in order to get at this invisible light under better conditions, if possible, than those with which he commenced operations, tested the transparency of the substances through which the light with which he experimented passed, and the transparency of glass was passed under review by him,* when he found that this invisible light, or whatever it was, could only get through glass with extreme difficulty. Continuing his investigations, he found that quartz on the other hand allowed this invisible light to pass. If you will allow me, I will read an extract from Prof. Stokes's paper of the extremest importance to our subject. After referring to these experiments on glass and quartz, he proceeds to say:†—"I have little doubt that the solar spectrum" (which you recollect had already been photographed to a certain extent both by Becquerel and Draper beyond the visible blue end of the spectrum), "would be prolonged, though to what extent I am unable to say, by using a complete optical train, in every member of which glass was replaced by quartz." He then adds that other substances which suggested themselves to him were not equally good. Then further, that if this invisible light does get through quartz, and does become visible to the eye, it does not at all follow that it will be capable of being photographed. Because already Prof. Stokes, in order to continue his researches in fluorescence, had been, as it were, driven to photograph some of the results which he had thus obtained. I am sorry to say that, so far as I can find out, none of those photographs have ever been published.

Before I go further, I think it will be convenient to throw on the screen some photographs of the solar spectrum, showing exactly what I mean by the "invisible rays;" and you will then see the enormous advance which Prof. Stokes made the moment he introduced his quartz train, and enabled both the eye and the photographer to take advantage of a new region of the spectrum in its entirety, in order to investigate it.

In a note to his paper communicated to the Royal Society, he shows that his anticipations, so far as the eye was concerned, were perfectly justified by the facts.‡ He says:—"I have since ordered a complete train of quartz, of which a considerable portion, comprising, among other things, two very fine prisms, has been already executed for me by Mr. Darker; with these I have seen the lines of the solar spectrum to a distance beyond H, more than double that of *p*. So that the length of the spectrum, reckoned from H (the outside line in the portion originally visible), was more than double the length of the part previously known from photographic impressions." I will now throw on the screen the spectrum of the extreme part of the visible portion. The eye generally can see the two dark bands which you see in the middle of the screen called H 1 and H 2. The least refrangible part of the spectrum lies to the right. When Prof. Stokes, therefore, stated that the solar spectrum was prolonged, he means that the part of the spectrum visible either to the unassisted eye or on a photographic plate after impression extends to a certain distance beyond these two dark lines. The part which Prof. Stokes rendered visible by means of his quartz train extended a considerable distance to the left beyond the part of the spectrum which you now see on the screen.

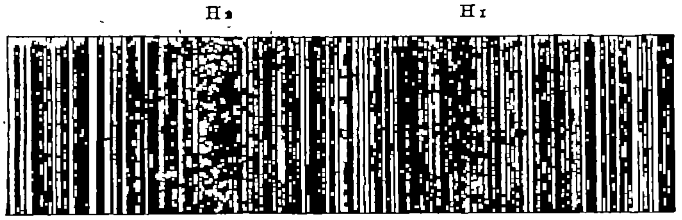


FIG. 2.—The H-lines in the blue end of the solar spectrum, from a photograph by the author.

So much for the solar spectrum. Now let me carry you on another ten years, to the year 1862. Prof. Stokes, in a paper communicated to the Royal Society in this year,† refers to his former paper, and to what he had been enabled to do by means of it. He states: "A map of the new lines [the lines thus observed by him] was exhibited at an evening lecture before the British Association, at their meeting in Belfast in the autumn of the same year, and I then stated that I conceived we had obtained evidence that the limit of the solar spectrum in the more refrangible direction had been reached. In fact, the very same arrangement which revealed, by means of fluorescence, the existence of what were evidently rays of higher refrangibility coming from the electric spark, failed to show anything of the kind when applied to the solar spectrum;" and then he goes on to say that, in making observations by means of the electric spark, he had found that in the case of a spark taken between the poles of an induction coil like this on the table, or between the poles of an electric lamp such as you see there, that the visible spectrum which was revealed and rendered visible to him by means of fluorescence was no less than six or eight times longer than the whole of the visible part of the spectrum. That you see, was a revelation of the first order. He was so astonished at this, that he at first thought there was some mistake. "I could not help suspecting that it was a mistake, arising from the reflection of stray light." In fact, so astonished was he, so many methods did he try in order to break down the impossibility, if it existed, that he adds, in a subsequent part of the paper, "I tried different methods, without being able to satisfy myself as to the accuracy of the observations, and frequently thought of resorting to photography."

Prof. Stokes thought of resorting to photography, but at the moment that Prof. Stokes was thinking of this, Dr. Miller, of King's College (unknown to Prof. Stokes), was not only thinking of resorting to photography, but had actually resorted to it, and was taking photographs of the so-called invisible part of the spectrum, in which the spectrum in the case of some substances was five or six times, and in the case of silver one might say almost seven times, as long as the spectrum ordinarily visible through glass prisms. Prof. Miller goes very nearly over the same ground that Prof. Stokes had done before him. He also investigated the transparency of quartz, and comes to the conclusion that quartz is almost the only substance that can be employed. Prof. Miller, in this paper, which you will find in the *Philosophical Transactions*,* also gives for the first time a detailed account of the way in which such work is done. Permit me to give you a rough notion of this method of work. We have here a spark from an induction coil, exactly such a spark as Dr. Miller wished to examine. He had a spectroscope something like this on the table, with two important differences. The first important difference was that instead of having two glass prisms he had prisms of quartz; and again, instead of having an observing telescope adapted for use by the eye, he inserted a camera, or what was to all intents and purposes a camera, in the same place. So that he had, first of all, a light source by which you get an intense illumination, due, as is generally imagined, to the extremely high temperature of the spark. Then you have a quartz lens, and quartz prisms, and then simply the photographic plate. Having therefore an entire absence of the non-transparency of glass, Prof. Miller was delighted to find that, on taking this spark in this way, between electrodes of different substances, he not only photographed what could be seen, namely, a spectrum ranging from red to blue, but one extending as a rule six times the length of the visible spectrum beyond the blue; although, in some cases, it is true it is only four times as long on the more refrangible side of H, as H is from the red end of the spectrum, that is to say the line which is generally called A. In this paper of Dr. Miller's we have the germ of all the applications of photography to spectroscopic inquiry which have been carried on since; and I am sorry to say that altogether too little has been carried on. Not only did Dr. Miller investigate in this way the radiation of different vapours, and give photographs for the first time of the bright lines of a very large number of chemical substances, but he went further than this, and dealt with the absorption of different substances.

---

* *Philosophical Transactions*, vol. cxlii., 1852.

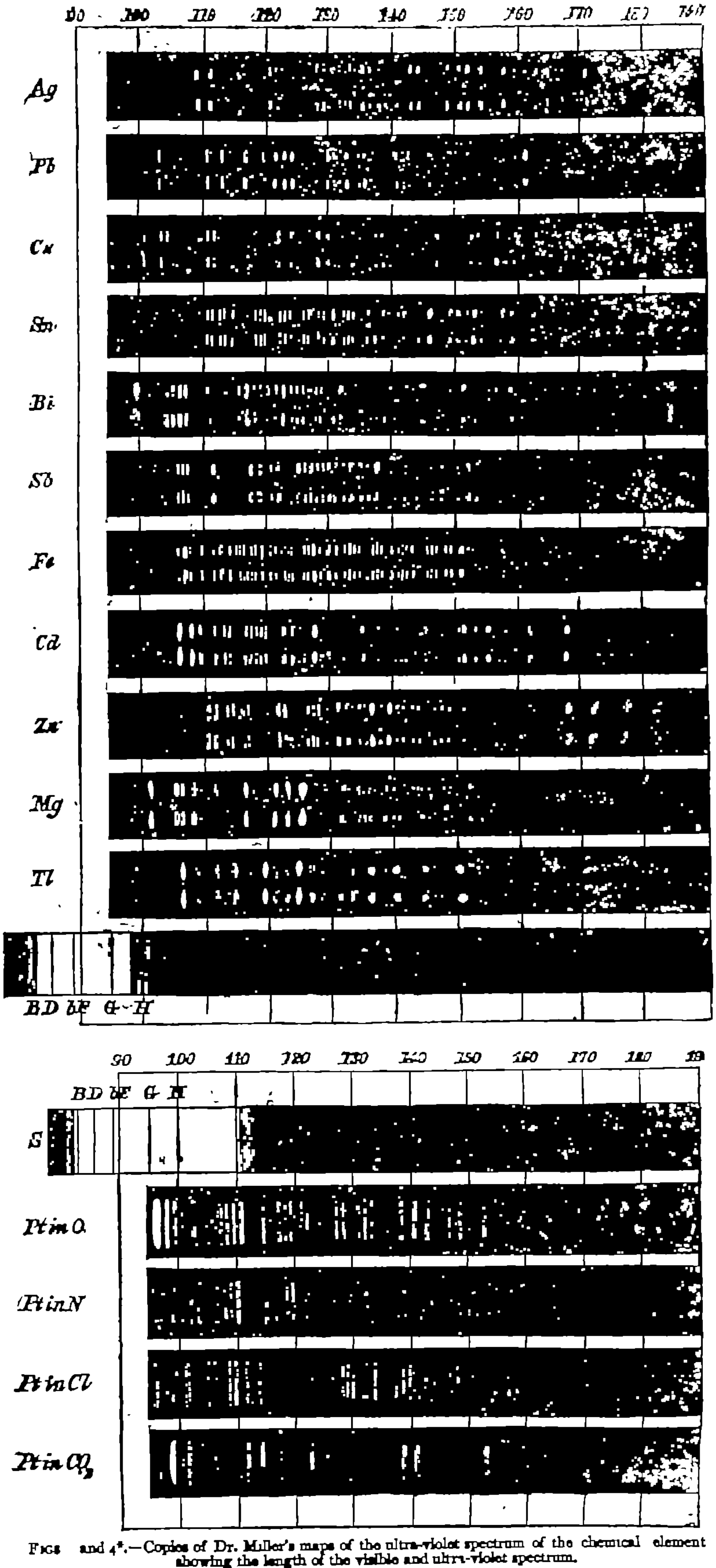
† On the long spectrum of the electric light. Phil. Trans., vol. clii. p. 599.

* Op. cit. Art. 200.

† Art. 204.

‡ Page 559

He commences his paper with the absorption of chemical rays by transmission through different media,—through solids (transparent, of course), through liquids, and through gases and vapours, the only alteration he made in his general mode of experimentation being that in the case of the absorption of gases and vapours he placed the instrument farther from the light source, and in the path of the ray inserted a tube containing the gas or vapour to be experimented with, as I am doing now, so that the light which passed from the spark to the telescope was compelled to traverse a thickness of vapour according to the length of the tube employed. In that way he not only determined the absorption of equal lengths of different vapours amongst themselves, but the absorption of different lengths of the same vapour; his paper is thus one of the most important contributions to spectroscopic knowledge that I am acquainted with, and I hold that the chief importance of it is the application of



Figs and 4*.—Copies of Dr. Miller's maps of the ultra-violet spectrum of the chemical element showing the length of the visible and ultra-violet spectrum.

* These have been obligingly placed at my disposal by Messrs. Longmans.—J. N. L.

---

* Vol. cit. p. 801.

photography to spectroscopic observations. There are few things so difficult, I think, as to make a proper spectroscopic observation, while from the little experience I have had at present I should think there is nothing more easy than to produce passable spectroscopic photographs.

That, then, was in the year 1862. In the year 1863 we have another equally distinct advance to chronicle, but this time the work is done in France. M. Mascart—a name very well known to physicists—undertook a tremendous work, which he has not yet completed, namely, a complete investigation of the ultra violet solar spectrum.* Instead of using a quartz prism, as Dr. Miller had done before him, M. Mascart uses a diffraction grating, that is to say an instrument by means of which the light is not refracted, as in the case of the prism, but diffracted by an effect of interference of fine lines ruled on glass. M. Mascart has shown it to be possible, by means of reflecting light from the first surface of the diffraction gratings, to get light diffracted without its going through the glass at all. In this way, therefore, you avoid altogether the imperfect transparency of the glass. Prof. Mascart has gone on advancing every year, until now he has completed a photographic map, not only of the solar spectrum extending about as far as the line R., by means of photography, but he has been able to observe as far as the line called T. There he finds the solar spectrum ends; but in the case of a great many vapours, such, for instance, as that of cadmium and other metals of the same nature, he finds he can go on photographing very much farther, and has been able to photograph almost as far as the eye can see, that is to say, to a distance, as I have already told you, five or six, or even seven times as far from the line H as H is from A. So that you see, thanks to photography, we can now photograph six times more of the spectrum than we can see of it with the eye ordinarily.

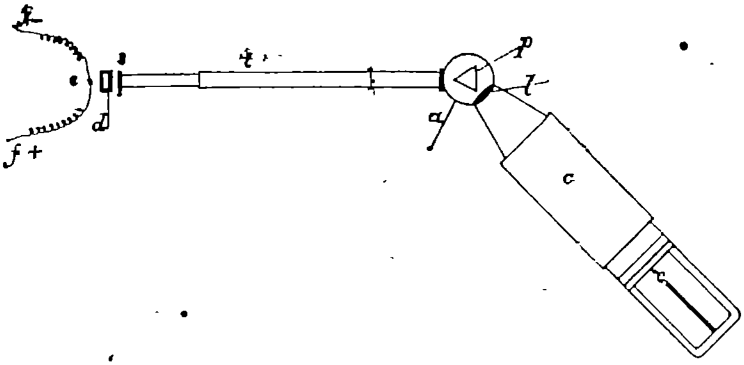


FIG. 5.—Dr. Miller's arrangements,—*s*, slit; *l*, quartz lens; *c*, camera; *p*, quartz prism; *t*, collimator.

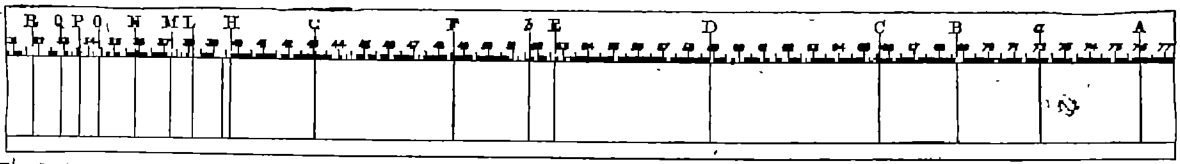


FIG. 6.—Wave-length solar spectrum showing the lines (from L to R) the positions of which have been determined by Mascart, and showing also how short the ultra-violet spectrum of the sun is as compared with that of the chemical elements.

J. NORMAN LOCKYER

(*To be continued.*)

THE CENTRAL PARK OF NEW YORK AND MR. WATERHOUSE HAWKINS

SOME time ago (NATURE, vol. vi. p. 70) we copied from the *American Naturalist* an account of the destruction "by order of Mr. Henry Hilton" of Mr. Waterhouse Hawkins' restorations of *Hadrosaurus* and other extinct animals, in the Central Park of New York. We have lately received some further correspondence on this subject, from which it appears that in April last Mr. Hawkins addressed to the Board of Commissioners of the Central Park a memorial, setting forth the manner in which he had been treated, and claiming compensation for his losses. It is not very easy to understand the origin of the affair, which appears to have occurred through some change in the government of the city of New York, produced by the notorious "Ring." But it is quite evident that Mr. Hawkins has the sentiments of all the leading scientific men of the United States in his favour.

Prof. Henry, of the Smithsonian Institution, speaks of the destruction of Mr. Hawkins' models as a "disgrace to the country, which nothing can wipe out, save a renewal of the work on a more liberal scale." Prof. Newbury, and other *savants*, write in a similar strain. There can therefore, we suppose, be no doubt that Mr. Hawkins will ultimately receive ample compensation for the treatment which he has received from Mr. Hilton and his subordinates.

EUCALYPTUS GLOBULUS IN MAURITIUS

THE subject of the introduction of the Eucalyptus as a sanitary agency in fever-stricken countries has of late been so much talked about that some authoritative preliminary inquiries have been made with the view of planting *Eucalyptus globulus* on a large scale in the Mauritius. From these inquiries, directed chiefly as to the possible success of the plant in the island, it appears that it does not thrive in any part, and still less in the warmer parts. The tree, moreover, is unsuited to resist the violent winds or hurricanes with which the Mauritius is so frequently visited. In 1865 twelve plants were planted in the Botanic Gardens at Pamplemousses, and though they were secured to strong stakes, eleven of them were destroyed in the hurricane of 1868; the remaining one also was blown over, but met with some support by falling into the branches of another tree, where it still remains.

Though it appears at one time thousands of young plants were planted in the lower parts of the island very few at the present time exist; there are, however, several specimens growing in the higher districts, at Vacoa and Moka; and a number of young trees were planted at Curepipe, of the success or failure of which, however, nothing can yet be said. Besides the frequent occurrence of devastating gales, the drought exercises an evil influence on the *Eucalyptus*, which is proved from the fact of the failure from this cause alone of 200 young trees that were planted and a quantity of seed that was sown last year on the signal mountains above Port Louis. As avenue trees to be planted on each side of the streets they are said to be the most unsuited of all the trees known in the island. The streets of Port Louis are, moreover, too narrow or too much crowded with traffic to admit of such planting.

---

* "Annales scientifiques de l'École normale Supérieure." Vol. for 1864, p. 219.

Above and beyond all these considerations it is the opinion that no system of planting, whether of groups or avenues, in the midst of the town, or of whole forests in the outskirts, nor yet a system of sewers and surface drains, would suffice to make Port Louis a healthy town. A perfect system of subsoil drainage throughout is considered the only possible means of a permanent improvement. The evil lies in the water, which soaks into the heavy clay subsoil, and having no means of escape becomes stagnant and putrefies. JOHN R. JACKSON

COGGIA'S COMET

THE following position of this comet was obtained here this evening by micrometrical comparisons with a star in the Bonn Catalogue. It should be pretty exact:—

June 9, at 10h. 23m. 34s. mean time at Twickenham.
R.A. . . . . 6h. 58m. 31·19s.
Decl. . . . . + 69° 2′ 3″·1

The comet is rather brighter than Argelander's stars of 6th magnitude, and the tail may be traced about 2° from the nucleus, which still presents a very stellar appearance.

The following orbit is the best I have yet seen, and was calculated by myself from the Marseilles observation of April 17, and two made at Mr. Bishop's observatory on May 9 and June 1; all the small corrections taken into account:—

Perihelion Passage, July, 8·2110 Greenwich mean time.

	° ′ ″	
Longitude of Perihelion ...	270 47 13	Mean Equinox, July 0.
,, Ascending Node ...	118 24 33	
Inclination to Ecliptic ...	65 51 31	
Perihelion distance	0·67437 (the earth's mean distance = 1)	
Heliocentric motion	Direct.	

The comet is steadily increasing in brightness, as indicated by theory. J. R. HIND

Mr. Bishop's Observatory,
Twickenham, Tuesday night

NOTES

WE are informed that the whole of the large and valuable collection of Natural History specimens procured by Signor D'Albertis during his recent travels in New Guinea has been purchased by the Italian Government, and that Signor D'Albertis himself will shortly return to the same island to continue his researches, which have already proved so important.

AT the last meeting of the Royal Geographical Society, held on Monday, June 1, Dr. Carpenter delivered a discourse entitled "Further Researches in Oceanic Circulation," in continuation of the communication he made to the Society on this subject four years ago. We understand that this lecture will be published in the Journal of the Society in full detail and with ample illustrations, and that it will contain a complete discussion of the results of the *Challenger* Temperature-Survey of the Atlantic.

MR. CLEMENTS R. MARKHAM, C.B., F.R.S., has been created a Knight Commander of the Portuguese Order of Jesus Christ.

THE Swedish Order of the Pole Star has been conferred upon Mr. Leigh Smith, the arctic voyager.

AT a Convocation of Durham University, held on June 2, certain alterations in the regulations were moved, the object o which was to prescribe the standing and exercises requisite for the academical rank of Associate in Physical Science, and of Mechanical, Mining, and Civil Engineers, which would enable students who had obtained the academical rank of Associate in Physical Science to become admissible to the degree of Bachelor of Science, provided not less than two years had intervened from the time of their being made Associates, after passing an examination in not less than six of the following subjects:—1. Mathematics (pure and applied); 2. Physics; 3. Chemistry; 4. Geology; 5. Engineering; 6. Biology; 7. Either Latin or Greek; 8. Either French or German; the two last of these subjects being compulsory. In title 8, sec. 1. of the regulations, it was proposed to add the following clause:—"That students of the Durham University College of Medicine, or of the Durham University College of Physical Science at Newcastle-on-Tyne, may petition the University that terms kept by them at either of these colleges, equivalent in duration to three terms kept by students in Arts at Durham, may count towards the degree of B.A., provided that they shall have passed the first examination appointed for students in Arts, which really takes place at the beginning of the second year, and that they shall not be admitted to the final examination for the degree of B.A. unless they have kept three terms at least by residence as students in Arts at Durham." The alterations were assented to.

THERE will be an election at Merton College, Oxford, in October next to two postmasterships, value 80*l*. per annum, tenable for five years from election, or so long as the holder does not accept any appointment incompatible with the full pursuance of his University studies. In the examination for these postmasterships papers will be set in algebra, pure geometry, trigonometry, theory of equations, and analytical geometry of two dimensions. Candidates must not have exceeded four terms of University standing. There is no limit of age. The examination will commence on Tuesday, Oct. 13, at 9 A.M. in Merton College Hall. Candidates are required to call on the Warden on the same day between 4 and 5 P.M.

AT the election to Mathematical and Physical Science Postmasterships in October, at Merton College, Oxford, an election will be made to two Physical Science Postmasterships, each of the value of 80*l*. a year, and tenable for five years from election, provided that the person elected do not accept any appointment interfering with the full course of University studies. There is no limit of age, but candidates, if already members of the University, must not have exceeded six terms from matriculation. The persons elected, if not members of the University, will be required to pass the University examination for responsions within a year of election. The subjects of examination will be Chemistry and Physics. There will be a practical examination in Chemistry. Candidates will have opportunities of giving evidence of a knowledge of Biology; but it must be borne in mind, that in such cases the examiners will look for evidence of an acquaintance with the principles of Chemistry and Physics equal in extent to that which is required in the Preliminary Honour Examination in the Physical Science School. A paper will be set in Algebra and Elementary Geometry, which, *cæteris paribus*, will be of weight in the election to the postmasterships. The examination will commence on Tuesday, Oct. 13, at 9 A.M. in Merton College Hall. Candidates are required to call on the Warden on the same day between 4 and 5 P.M. Further information may be obtained from the Tutor in Physical Science.

THE annual *conversazione* of the Society of Arts will be held on the 19th inst. at the South Kensington Museum.

MR. WILLETT, the hon. secretary to the Sub-Wealden exploration, reports that up to the end of the week before last a total depth of 967 ft. 8 in. had been attained, so that the present contract to bore 1,000 ft. may be taken as virtually complete. A continuation of the work will require an immediate expenditure of 500*l.* for lining tubes, and every additional foot bored to 1,500 ft. or 2,000 ft. will cost at least 2*l.* Thus, to enable another 500 ft. to be bored, subscriptions to the amount of 1,500*l.* must be forthcoming. The boring continues in the Kimmeridge clay. At a depth of 883 ft. the core contained a shell of the Arca species, which is entirely new to Science. At a meeting of the central committee it was moved and carried unanimously:—"That, as such important economic and scientific questions are awaiting their solution by the completion of this undertaking, it is most desirable that the work should be continued, and that a sub-committee be appointed to draw up a statement and an appeal for pecuniary support, and that such sub-committee consist of Prof. Ramsay, F.R.S., Director-General of the Geological Survey of England; Mr. John Evans, F.R.S., President of the Geological Society; and Mr. J. Prestwich, F.R.S., ex-President of the Geological Society." These gentlemen having consented to act, the hon. secretary solicits subscriptions, that the desired result may be attained.

Les Mondes announces the death of Mme. Liais, the wife of the director of the Observatory of Rio de Janeiro, who acted as the secretary of and co-worker with her husband in all his labours. She accompanied him in his dangerous expeditions into the centre of Brazil, and died in consequence of the sufferings she endured during her travels with her husband.

M. A. L. A. FÉE, the well-known French botanist, died on the 21st ult., in his 86th year.

M. FORTIN, who recently died, has left all his fortune, amounting to 36,000*l.*, to the city of Paris, on condition that it will be employed in building schools for children of both sexes.

Allen's Indian Mail learns from Calcutta that the Indian Government proposes before long to resume the surveys of the Indian coast line on an extensive scale. The work will be taken in hand next cold season under the supervision of Capt. A. D. Taylor, late of the Indian Navy. The operations will be generally directed by Col. Thuillier, Surveyor-General.

AT a Cambridge congregation held on June 4, an additional grant of 300*l.* was voted for the maintenance of the new Museums and Lecture rooms. The Vice-Chancellor, Dr. Power, Dr. Phear, Dr. Humphry, Professors Stokes, Liveing, and Hughes, Mr. Bonney, St. John's, and Mr. Hart, Emmanuel, were appointed a syndicate to collect information as to the space and accommodation required for a new Geological Museum, and were ordered to report before the end of next Michaelmas Term. The seal of the University was affixed to a letter of thanks to the Chancellor, the Duke of Devonshire, for his munificent gift of the Cavendish laboratory of Experimental Physics.

IN the last article on The Coming Transit, it was mentioned that the Royal Society had appointed three naturalists to accompany the Transit Expedition to Rodriguez. This Natural Science Staff will consist of Mr. Henry Slater, B.A., as geologist, Mr. Balfour, son of Prof. Balfour of Edinburgh, as botanist, and Mr. George Gulliver, B.A., as zoologist.

PREPARATIONS are being made for holding a national festival to commemorate the discovery and colonisation of Iceland by the Norsemen 1,00 years ago.

ONE of the principal points to note in Dr. Acland's Report to the Radcliffe Trustees for 1873, is the grant made by the trustees of 100*l.* to be expended in the promotion of higher medical science in connection with Oxford University. Of this twenty-five guineas were granted to Messrs. C. C. Pode and E. Ray Lankester to aid them in their researches concerning Bacteria. Mr. Pode unfortunately died, but the research is being carried on by others.

WE take the following extract from an article in the New York *Nation*, entitled, "Who shall direct the National Surveys?":—"It is little short of absurd that scientific work should be voted a military matter, to be carried on only under the oversight of men who have military education. Unless, indeed, experience had already shown, or should show hereafter, that scientific men are not to be found who are capable of directing surveys as well as of doing the work required upon them; or that the methods of military topography are the best basis for the complete geographical and geological exploration of a region; or that civilians work more happily and effectively under the government of military men—and there are facts in abundance to disprove each and every one of these hypotheses. It would seem a little less unnatural that the Navy Department should claim to undertake the management of the foreign diplomatic service because it has well-educated officers lying idle and ships to carry them to their destinations. Army and navy are often good initiators; but there comes a time when, in all the proper arts of peace, *arma cedunt togæ.* And if the country has more educated military talent than it needs for military purposes, profitable occupation can surely be found for it without putting it in authority over scientific men engaged in carrying on the work for which they have been trained and to which they have devoted their lives."

WE are glad to see that a British Bee-keepers' Association has been formed "for the encouragement, improvement, and advancement of bee-culture in the United Kingdom." Its first exhibition will be held at the Crystal Palace on Sept. 8, 9, and 10, when a large number of prizes will be offered. The hon. secretary is Mr. John Hunter, Eaton Rise, Ealing.

THE *Linguist, and Educational Review*, "a cheerful, instructive, and interesting periodical on languages, anthropology, antiquarian research, literature, education, science, and the fine arts," is the name of a new monthly journal to be published on July 1, by Thomas Cook and Son and Hodder and Stoughton.

SYMONS' *British Rainfall* for 1873 has come to hand, and for the immense amount of labour involved in sifting and arranging the vast mass of material, all meteorologists ought to be grateful to Mr. Symons. He has many difficulties to struggle with, including 200 lazy correspondents, who are usually months behind in sending in their statistics. We regret to see that Mr. Symons' request, that one or two gentlemen in each county would have the kindness to volunteer to assist in seeing that their county is not neglected, has been acted on in only a very few cases. It is possible that many who would be willing to comply with the request are ignorant of it; we hope Mr. Symons will have a better report to give in this respect next year. Mr. Stow's paper, On Scotch mist, is worthy of attention.

A SUPPLEMENTARY part of Petermann's *Mittheilungen* contains four lectures On the Caucasus, by Dr. G. Radde. Lecture I. treats of the configuration of the Caucasus; II. Of the organic world of the region; III. Of the inorganic world in its relation to the wants of man; and IV. Of the present inhabitants of the Caucasus, their condition, industries and prospects. Three good maps accompany the lectures; one a general map of the country, another showing the extent of forest, and a third the density of population.

COUNT WILCZEK, the Austrian traveller, the *Geographical*

Magazine informs us, is preparing for a second arctic voyage during the season to Novaya Zemlya. He intends to launch provision-laden balloons in various directions in the hope of succouring the Austro-Hungarian *Tegethoff* expedition.

WE learn from the *Geographical Magazine* that the surveys in connection with the European measurement of a degree have been resumed, under the direction of Col. Granhal of the Austrian and General de Vecchi of the Italian Engineers, who are now measuring a base-line in the neighbourhood of Udine.

ON Saturday last the foundation-stone of a fine new museum in connection with the Torquay Natural History Society was laid by the president, the Rev. T. R. R. Stebbing. The Society was founded in 1844, by a few gentlemen of Torquay, among whom was Mr. Pengelly, and has had a most prosperous career in all respects. The contents of the Museum, wholly Devonian, are of high scientific value. Among the contents of the bottle placed in the cavity of the foundation-stone, was a copy of the last number of NATURE, containing a portrait of Mr. Darwin.

AN extract from a letter by Mr. Dunn, the geologist, now on a special exploring expedition to the Transvaal, published in the *Cape Argus* of May 5, gives a description of a thunder and hail-storm which he experienced at Pietermaritzburg, on April 17:—"Hail-stones, liberally mingled with great masses of ice of very irregular forms, poured down with great violence. The hail-stones were seldom less than 1 in. in diameter; the average was from 1¼in. to 2 in. in diameter. These were of very regular spherical form, and consisted of a nucleus of white snow, with an envelope of hard transparent ice. Sometimes they presented, when broken through, a concentric arrangement of zones, alternately white and opaque and transparent. The irregular masses were formed of a nucleus generally longer in one direction than the others, from 2 in. to 4 in. in diameter; projecting all over were stalactites, each one about the thickness of a little finger, and presenting, when broken across, an agate-like structure, as though segregation had built them up. Of these masses I weighed a few with the following results:—Three weighed over 8 oz., two over 6 oz., and one over 4 oz. The mischief done will not be covered by 2,000*l.* or anything like that sum."

M. W. DE FONVIELLE made a balloon ascent on May 27, in the "Guillaume Tell." He ascertained the existence of an aerial stream 2,000 ft. thick, blowing with a velocity of 4 yards per second, in a south-east direction. From that current up to 10,000 ft. the air was running in a southerly direction, with nearly the same velocity. The temperature was only 42° F. at 8,000 ft., and rapidly increased when nearing the earth, where it was 77°. The lower part of the northern current for 1,800 ft. was limpid air. At an immense height were floating strata of cirrhus, almost parallel. The landing took place after having run 42 miles in only 40 minutes. Several experiments on sound were made, and others will be made shortly.

THE additions to the Zoological Society's Gardens during the last week include a Great Anteater (*Myrmecophaga jubata*) from the Argentine Republic, presented by Mr. J. Mendez; a Temminck's Snapper (*Macroclemmys temmincki*), a North American Trionyx (*Trionyx ferox*) and other Chelonia, presented by the Smithsonian Institution of Washington; a Red Deer (*Cervus elaphus*), European, presented by Lord H. Russell; a Vervet Monkey (*Cercopithecus lalandii*) from West Africa, presented by Commander J. H. Smith; a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Mr. J. E. Kincaid; a Griffon Vulture (*Gyps fulvus*), European, presented by Mr. S. Reid; a Stanley Crane (*Tetrapteryx paradisea*) from South Africa, purchased.

SCIENTIFIC SERIALS

THE current number of the *Quarterly Journal of Microscopic Science* contains several articles of interest, most being condensed accounts of longer papers from British and foreign sources. The first memoir is by Mr. Francis Darwin, entitled "Contributions to the Anatomy of the Sympathetic Ganglia of the Bladder in their Relation to the Vascular System." The author's object is to show that there is a reflex mechanism effected by peripheral ganglion cells, through which the coats of the arteries are placed under nervous control, independent of the central nervous system; so that the statement of Cohnheim to the contrary in his "New Researches on Inflammation" does not hold. Mr. Darwin illustrates his views by two excellent plates, which demonstrate that in the bladder at least the ganglionic nerve fibre or fibres (for there are generally two) which accompany each small artery, send branches which are partly distributed to the coats of the vessel, and are partly lost on its outer covering.—This paper is followed by a further *résumé* of recent observations on the Gonidia question, by Mr. W. Archer, which commences with the adverse comments of Fries and J. Muller on Schweindener's peculiar theory respecting the relation borne by the gonidia to the lichen-thallus, and is followed by an abstract of the researches of Bornet in the same direction, but favourable to the parasitic hypothesis.—Mr. W. Hatchett Jackson proposes a new method for preserving magenta-stained microscopic sections which he has found successful. Magenta being a trianime, its triacid salts colourless, and nearly all of them soluble in most preservative solutions, it was desirable to obtain a stable mon-acid salt and a suitable preservative fluid. These conditions are fulfilled by employing as the staining agent the monotannate of magenta, and as the preservative fluid syrup, with 3 or 4 per cent. of calcium chloride. Specimens prepared and mounted by this method have been kept for more than a year, the sugar making them very transparent.—A translation is given by Mr. Perceval Wright of part of Prof. Haeckel's now well-known Gastraea theory, the phylogenetic classification of the animal kingdom, and the homology of the germ lamina. The gastraea theory, which is very similar to one published shortly before it by Mr. E. Ray Lankester, divides the animal kingdom into two chief divisions, the Protozoa and the Metazoa, the former of which never form germ laminæ, never possess a true intestinal canal, and, especially, never develop a differentiated tissue; whilst the latter always form two primary germ laminæ, always possess a true intestinal canal, and always develope differentiated tissues. The Metazoa are further divisible into the Zoophyta (or Coelenterata) and the Bilateria (or bilaterally symmetrical animals).—The last article in the number is an account of Dr. Cunningham's report on the microscopical examination of air, from experiments prosecuted at Calcutta, undertaken with the view of throwing light on the origin of cholera and other eastern epidemics.

Journal of the Chemical Society, April.—This part contains the following papers:—On the products of decomposition of castor oil. No. I. Sebacic acid, by E. Neison. The author prepares the acid by mixing equal weights of castor oil and sodium hydrate with sufficient water to form a pasty mass, and then heating this mass till it solidifies. The product thus obtained is quickly distilled in a copper flask (200 grms. at a charge), the residue dissolved out of the flask by boiling water, and the sebacic acid precipitated from the solution by hydrochloric acid, the precise method of precipitation being varied according to the stage to which the distillation has been carried. The yield is small, 1 kilog. of oil giving only about 50 grms. of the acid. Analyses of numerous salts are given.—Action of benzyl chloride on laurel camphor (*Laurus camphora*). Preliminary notice, by Donato Tommasi. The reaction is performed in presence of powdered zinc, and the chief product appears to be toluene.—On the action of trichloracetyl chloride upon amines. I. Action upon aniline, by D. Tommasi and R. Meldola. The result of the reaction is phenyl-trichloracetamide $N\left\{\begin{matrix}C_6H_5\\C_2Cl_3O\\H\end{matrix}\right.$. This by treatment with fuming nitric acid yields a dinitro derivative $N\left\{\begin{matrix}C_6H_3(NO_2)_2\\C_2Cl_3O\\H\end{matrix}\right.$ —Isomeric terpenes and their derivatives. Part III. On the essential oils of wormwood and citronella, by C. R. A. Wright. The author has studied the action of zinc chloride, and of phosphorus pentasulphide upon absinthol and citronellol; also the action of phosphorus pentachloride and of bromine on this latter substance. The cymene obtained from absinthol and citronellol yields terephthalic and acetic acids on oxidation.—On the perbromates. Preliminary notice, by M. M. Pattison Muir. The author has undertaken the preparation of a number of these salts. —On two coals from Cape Breton, their cokes and ashes, with some comparative analyses, by Henry How. The remainder of the journal is devoted to abstracts from British and foreign journals.

THE *Geographical Magazine*, June.—This number opens with a valuable article by Mr. C. R. Markham, on the Railways of Peru.—The longest and most important paper, from a scientific point of view, is by Mr. H. P. Malet on Bone Caves, in which the author's conclusions differ in several points from those generally accepted.—Other articles are on Singapore, and on the British colonial wool trade, by Mr. W. Robinson.—In connection with the American Geographical Society, letters are given from Capt. Buddington, and three other officers of the *Polaris* expedition, in which all but Buddington agree in stating that had Hall lived the ship would have pushed much further north, and that there would be no difficulty in some future properly equipped expedition doing so.

THE *Geological Magazine*, June.—The original papers in this number are the following:—Description of *Cycloptychius*, a coal measure fish, by Dr. R. H. Traquair, with a plate; Physical changes preceding deposition of cretaceous strata, by C. E. de Rance, F.G.S.; On *Columnopora*, a new tabulated coral, by Prof. H. A. Nicholson, F.R.S.E., with a woodcut; Glaciation of West Somerset, by W. C. Lucy, F.G.S.; On the South of England ice-sheet, by James Croll, of the Geological Survey of Scotland; On *Polypora tuberculata* in Scotland, by Prof. J. Young, M.D., and Mr. John Young, Hunterian Museum, Glasgow; Landslips and Sinkings in Cheshire, by J. M.

Journal of the Society of Telegraphic Engineers, No 5.—The principal original papers in this part are the following:—On a method of testing short lengths of highly insulated wire in submarine cables, by Prof. Fleeming Jenkin, F.R.S.; On the mechanical testing of telegraph wires, by R. S. Culley; On the strength of cylindrical wrought-iron telegraph poles, by F. C. Webb; On the percentage of averages, by W. H. Preece; On lightning protectors, by John Fletcher; On equations connected with telegraph wire, by H. Mallock; Tables to facilitate the calculation of strains of overhead line wires, by Robert Sabine.

Transactions of the Glasgow Society of Field Naturalists. Part II. Session 1873-74.—This Society was established in 1871, and seems to be in a prosperous condition so far as members are concerned, and, to judge from the brief reports of the meetings, is doing good work. The Society meets all the year over, specimens being exhibited and papers read at all the meetings; the papers contain the results of observation as well as occasionally of speculation, and show that the members can observe and think to good purpose. In summer the Society makes excursions to various places in Scotland, an account of the results of these excursions being read at the meetings. The paper of greatest novelty in this publication is Contributions to a knowledge of the Scotch Cynipidæ, by Mr. P. Cameron.

Astronomische Nachrichten, Nos. 1,989, 1,990.—In these numbers is contained a long paper by J. G. Galle on a method of calculating the paths of bright meteors, and he gives the orbits of the meteors of July 11 and 19, 1873. The elements of Planet (127) are given by Henry Renan. The elements of Coggia's comet are given by A. C. Dunér as follows:—

$$T = 1874,\ \text{July } 20{\cdot}1670 \text{ Berlin time}$$
$$\pi = 150^\circ\ 3'\ 16''$$
$$\Omega = 123^\circ\ 1'\ 55''$$
$$i = 72^\circ\ 52'\ 53''$$
$$\log.\ q = 9{\cdot}86894$$

The ephemeris for this comet is added, going up to Aug. 11.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti: t. vii. Fasc. v.—In this number M. Celoria has a note On the extremes of temperature observed in Milan since the year 1763. It appears from his table that the minimum temperatures of the several years occurred 63 times in January, 27 in December, 19 in February, once in March (1785), and once in November (1866). The maximum temperatures occurred 62 times in July, 33 in August, 13 in June, once in May (1786). It is further observed that the minimum temperature in Milan is, on an average, −9°·57 (oscillating between −2°·8 and −17°·2); while the maximum temperature is, on an average, 34°·38 (oscillating between 31°·5 and 37°·7). The average mutability of temperature is thus 43°·9. The author also furnishes some data as to days of frost at Milan in 1838–73. The average number of these is found to be about 58; there was a minimum of 17 in 1872, and in the two years 1848 and 1858 the number rose to 85.—Prof. Mantegazza contributes a paper On the expression of pain. He groups all modes of painful expression in three categories; viz. expressions of reaction, expressions of paralysis, and mixed expressions of pain and of different sentiments.—Prof. Garvaglio has a paper in vegetal pathology, treating of a parasitic fungus which produces a form of blight in rice.—Prof. Sayno describes some applications of the spiral of Archimedes to graphic calculation.—In the section of moral and political science, Prof. Cossa contributes a paper On political economy of people and states.

Annali di Chimica applicata alla Medicina. Nos. 3 and 4, March and April, 1874.—Under the heading of "*Pharmacy*" we notice in these numbers a paper by Carlo Pavesi on the compound of chloral hydrate with glycerine.—One by Giovanni Ruspini on the metallurgy and applications of bismuth.—F. Mayer contributes a note on the assay of alkaloids, and Leger one on metatartrate of magnesia.—Bultot writes on an alteration of bichloride of mercury.—Prof. G. Bizio contributes a paper on protosulphide of phosphorus.—In hygiene there is a paper on the disinfection of drains, by Prof. S. Zinno.—In toxicology C. Ménière d'Angers contributes a paper on the toxical properties of *salmoja*, the residue obtained in salting meat and fish for exportation; N. Zuntz on the nature of the compound of carbonic oxide with hæmoglobulin; Huseman on antidotes for phenic acid.—From the *Journal de Pharmacologie* two papers are translated, one on a case of arsenical poisoning, and one on the frequency of phenol poisoning in England.—In physiology there is a paper by Engel on metals and the human body; and a paper by G. Gallo on a new fact favouring heterogenesis. We notice also an account of experiments on the production of bacteria in organic infusions, by E. R. Lankester, and a paper on the physiological and therapeutic effects of the active principle of ipecacuanha, by A. E. d'Orenellas.—In therapeutics S. Cadet has a paper on the efficacy of black sulphide of mercury in cholera; Dr. Gimbert on the application of *Eucalyptus globulus*; Prof. Binz on the action of bromide of potassium on the animal organism; L. Tassinari on the transfusion of blood; Prof. de Renzi on the use of sulphites in intermittent fever; and on the injection of water and saline solutions into the veins in cholera, by Dr. Dujardin-Beaumetz.

Gazetta Chimica Italiana. Fasciolo iii. contains but two original communications, the first of which is by E. Paterno, On the identity of cymene from camphor and from essence of terebenthene. The cymene was prepared from camphor by a modification of Pott's process, enabling more than a kilog. of this substance to be acted on at once. 100 grm. of red phosphorus, 265 grm. of sulphur, and 780 grm. of camphor are well mixed in a suitable vessel, and then heated over a gas burner till cymene ceases to pass over. Analyses and descriptions of the calcium, barium, lead, potassium, sodium salts of cymene-sulphonic acid, from camphor cymene, as well as of the acid itself, are given.—Cymene from essence of terebenthene was prepared by Riban's method, and the same salts of the sulpho-acid studied.—The other paper is by Ugo Schiff on chromic peroxide and acid, being observations and experiments relating to a paper by E. Hintz (under the direction of Prof. L. Meyer) on these substances. The remainder of this part is occupied by abstracts from other journals.

Cosmos, May.—The principal papers in this number of the Italian geographical journal are an account of N. M. Prjewalsky's exploration of eastern Mongolia, the *present contribution relating* to his travels in the southern confines of Mongolia from Dala-Noor to Ala-Shan; On the gold-bearing regions between the Limpopo and Zambesi, with a map; and a continuation of the paper on recent expeditions into New Guinea.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, May 27.—John Evans, F.R.S., president, in the chair.—The following communications were read:—On the last stage of the Glacial period in North Britain, by T. F. Jamieson. In this paper the author arranged the Glacial phenomena of Scotland under the three following heads:—(1) The great early glaciation by land-ice (maximum effects of glaciation). (2) The period of Glacial marine beds containing remains of arctic mollusca, when most of the country was covered by the sea. (3) The time of the late glaciers, the special subject of the paper. After expressing himself in opposition to the hypothesis of a great polar ice-cap, the author described this last period as one not of mere local glaciers, but as characterised by a return of a great ice-sheet over nearly the whole of Scotland and Ireland; but he stated that this ice-sheet was probably neither so thick, so extensive, nor so enduring as that of the first period of glaciation, which cleared away everything in the shape of superficial deposits, down to the hard rock. He believed, however, that in the last period the mountains of Scotland and Wales, as well as the Pennine range and the rest of the north of England as far as Derby, were covered with thick ice, which in most parts reached down to the sea, and that extensive snow-beds prevailed over the rest of England. In the summer months the melting of these would give rise to streams of muddy water, and produce the superficial deposits of brick-earth, warp, and loess; whilst when the currents were stronger, perhaps from the thaw being unusually rapid, deposits of gravel would be formed. This second ice-sheet would gradually become less and break up into valley-glaciers, which in their retreat would leave kaims and eskers at low levels, and moraines in the mountain-glens. During this time no new great submergence of the country took place; and the last great modifications of the surface were sub-aerial, and not submarine, the work having been done by frost, rain, and glaciers.—Notes on the Upper Engadine and the Italian valleys of Monte Rosa, and their relation to the glacier-erosion theory of lake-basins, by the Rev. T. G. Bonney. The author stated that he had examined (1) the small lakes on the summit of the Bernina Pass. These were situated in a position very favourable to glacier-erosion, and he thought might be attributed to that cause. (2) The lakes on the upper part of the Maloya Pass. These lay in three rock-basins, and at first sight seemed favourable to the glacier-erosion theory; but further examination showed that they were in no way connected with the Glacial system of the neighbourhood, and were probably Preglacial. (3) The Val Bregaglia to the Lake of Como. The presence of barriers in the valley, its frequent V-like form, and the signs of Glacial action to near the present level of the stream, seemed to indicate that the glacier had had but slight erosive power. (4) The Como arm of the lake. It was shown that the glacier, which was supposed to have excavated the lake, had passed over the ridge of Nagelfluhe and Molasse that encloses it, and had not been able to grind away its remarkably sharp crest. (5) Similar evidence was produced with regard to the Lake of Orta. (6) The Italian valleys east of Monte Rosa. These were shown to offer difficulties precisely similar to those of the Val Bregaglia. The author therefore argued that these cases showed how superficial the action of the glaciers had been; and that they must have been wholly inadequate to excavate the greater lake-basins, since no approach to this form, no U-like trough, was found in the valleys down which the glaciers had flowed on their way to the lakes. As then the principal features of the district appeared to be Preglacial, he contended that disturbances of beds of the valleys along lines transverse to their direction were more likely to have produced the lakes.

Zoological Society, June 2.—Arthur Grote in the chair.—A letter was read from Mr. T. D. Forsyth containing an account of some of the animals met with in the vicinity of Kashgar.—An extract was read from a letter received from Mr. E. P. Ramsay, relating to a living cassowary (*Casuarius australis*), which he was proposing to send to the Society's collection.—Prof. Owen, F.R.S., read the fifth part of his series of memoirs on the "Osteology of the Marsupialia." This portion contained a general account of the osseous structure of the kangaroos.—Lieut.-Col. H. Irby exhibited specimens of apparently a new species of raven, which he had lately obtained in the vicinity of Tangier, Morocco, and which he was intending to describe under the name of *Corvus tingitanus*.—A communication was read from the Rev. O. P. Cambridge, on some new species of the Arachnidean family of *Drassides*, from various localities.—A communication was read from Dr. E. Grube, containing descriptions of new Annulata collected by Mr. E. W. H. Holdsworth on the coasts of Ceylon.—A communication was read from Mr. W. Nation on the habits of *Spermophila simplex*, as observed in the vicinity of Lima.—A communication was read from A. G. Butler containing a list of the butterflies of Costa Rica, with descriptions of new species.

Chemical Society, June 4.—Prof. Odling, F.R.S., president, in the chair.—The following papers were read:—1. Dendritic spots in paper, by H. Adrian. These he finds to consist of sulphide of copper, formed from particles of gun metal, derived from the machinery employed in manufacturing the paper; they are far more usually found in common paper than in the better classes. 2. The acidity of normal urine, by J. Resch, M.A. 3. On a simple method of estimating urea in urine, by Dr. Russell and Mr. West. The apparatus employed for this purpose was exhibited, and a practical illustration given by Mr. West. 4. On ipomæic acid, by E. Neison and J. Bayne. This acid, prepared by the action of nitric acid on jalapin, the authors find to be identical with sebacic acid. 5. On certain compounds of albumin with the acids, by G. S. Johnson. 6. On sulphide of acetyl, and 7. On a new method of preparing toluene: both by Dr. D. Tommasi. 8. Note on New Zealand Kauri gum, by M. M. P. Muir.

Royal Horticultural Society, May 27.—Scientific Committee.—R. M'Lachlan, F.L.S., in the chair.—The Rev. M. J. Berkeley remarked with respect to the Thread Blight of the tea in Assam:—"I have carefully examined the thread blight in company with Mr. Broome. We could find not the slightest trace of fruit, and therefore we are unable to say to what genus its perfect state belongs. It seems to run indifferently over plants belonging to very different natural orders." The leaves of *Andrachne trifoliata*, a plant which it also attacks, are very much damaged by minute lichens belonging to the genus *Strigula*. In one perfect asci were discovered with minute sausage-shaped sporidia, in the other only stylospores were found, but of a very peculiar character. They were staff-shaped, hollowed out on either side, septate, and seated on very long pedicels." Mr. Berkeley also placed before the committee a curious fungus from New Jersey, which affects *Cupressus thuyoides*. Mr. J. B. Ellis, who sent it him, remarks, "It grows from the same matrix yearly, generally at the extremities of the branches, which it causes to swell and branch in a brush-like or digitate manner." It appeared to agree with *Podisoma* except in possessing no gelatinous investment, and would appear to constitute a new genus.—Mr. M'Lachlan remarked, with reference to the *Termes* exhibited at the last meeting from the wood of Zanzibar copal (*Trachylobium*), that he had ascertained that it did not belong to the subgenus *Eutermes*, but to *Calotermes*. It seems to be an undescribed species, allied to *Calotermes solidus* Hagen, but differing slightly. The original locality for that species is unknown. Hagen, in his monograph of the family, speaks of having seen two specimens of *C. brevis*, a species from Central and South America, inclosed in copal. It would not be expected to find an American species under these conditions, and the individuals in question may possibly have been the same as those from Kew. In the south of France two small indigenous species (one belonging to *Calotermes*) do considerable damage, and a small North American species (*Eutermes flavipes*) had at one time established itself in the hot-houses of the gardens of Schonbrunn, at Vienna, principally infesting the tubs in which plants were growing.—Mr. Andrew Murray sent a note on the section of a stem of *Macrozamia spiralis*, exhibited at the last meeting, and which was completely riddled by the borings of a weevil, described by Mr. Pascoe under the name of *Tranes internatus*.—Prof. Thiselton Dyer read the following extract from a letter addressed by Mr. W. H. Tillett to Dr. Hooker:—"April 26.—*Philodendron selloum* is now in bloom again. Last night I fancied it was emitting heat, and in testing this with a thermometer found it was so. The heat in the house was 58° F., and the thermometer rose at once to 68° F. I have tested it again this evening, and the thermometer rises from 58° F. to 74° F. April 27.—Testing the *Philodendron* last night, I found it was 35° F. above the temperature of the house. The house was 56°, and the flower—one newly opened—91°."—Dr. Voelcker thought the committee would like to know the results of his investigation of the soil of a London square in which Messrs. Veitch had twice planted planes, which in each case had died. He found, on examining the clear watery solution from treating the soil with distilled water, that the soil contained one-tenth per cent. of common salt and two-tenths per cent. of nitrates. Now it was obvious that this was really a considerable quantity, when it was considered that one-tenth per cent. of common salt would amount to a ton mixed with 6 in. of soil over an acre. He might say parenthetically that whenever the amount of chlorine in soil reached anything like an appreciable quantity, it exercised an injurious influence.

General Meeting.—Henry Webb in the chair.—The Rev

M. J. Berkeley commented on the injury done to pears by a species of *Cecidomyia* and also by a fungus *Helminthosporium pyrorum* which produced the unsightly cracking of the surface.

Royal Microscopical Society, June 3.—Charles Brooke, F.R.S., president, in the chair.—Mr. Slack called attention to a slide exhibited under one of the Society's microscopes, as being a remarkable specimen of Herr Müller's technical skill in diatom mounting. The slide had photographed upon it, in an extremely beautiful and perfect manner, eighty spaces with the names of diatoms below each, and a diatom of corresponding species was mounted in every space.—Mr. Charles Stewart described and figured on the blackboard the peculiar position of the touch-corpuscles in the skin of the hand; he also exhibited and described a section of an Ascidian, and explained the method of preparation.

BOSTON, U.S.

Society of Natural History, Jan. 7.—Dr. T. Sterry Hunt read a paper on the stratification of rock-masses. The crystalline rocks are commonly divided into stratified and *unstratified*. *These two classes* correspond to what the author has designated indigenous and exotic rocks, but a third class must be distinguished, which he has called endogenous rocks, and which appear to have been deposited from solutions, not in open basins, but in fissures at greater or less depths from the surface, and under peculiar conditions of temperature and pressure. To these crystalline deposits *belong the various* veinstones, *including many of the* so-called granites, especially *those containing* the rarer mineral species. The speaker desired to call attention to the fact that a stratiform or layer-like arrangement of the constituent parts is often met with, both in exotic and endogenous rocks, and cannot be regarded as characteristic of indigenous rocks, nor as a proof of aqueous deposition at the earth's surface. While admitting the frequent occurrence of the banded structure in *eruptive rock*, and the necessity in many cases of a careful geognostical study to determine to which class a stratiform rock should be referred, the speaker maintained the truly indigenous character of the great formations of gneissic rocks, such as, for example, the Laurentian, which from their wide extent, and from the mode of their association with layers of quartzite, limestone and iron-oxides, were clearly deposited in horizontal layers at the earth's surface.

Feb. 4.—Mr. J. A. Allen read a paper on geographical variation in colour among North American squirrels, exhibiting many specimens in illustration of his remarks. The law of geographical variation in size, that *representatives of the same species* decrease in size with decrease in latitude or altitude of their range, was established by Prof. Baird in 1857-58, in respect to both mammals and birds, who also noticed the occurrence of variation with locality in some other respects. Laws have been found to govern these variations as well, and are as follows:—(1) enlargement of peripheral parts towards the southward; (2) increase in depth, intensity, and extent of dark colours towards the *southwards, and* (3) *increase of colour* with *increase* of humidity, or the correlation of intensity of colour and the mean annual rainfall. Mr. Allen then proceeded to notice the application of these laws to the family of squirrels.—Prof. C. H. Hitchcock spoke of his studies of the Helderberg rocks of New Hampshire. He also described in detail the geology of the northern part of Grafton County, New Hampshire, where the Helderberg Rocks can be best studied.

PARIS

Academy of Sciences, June 1.—M. Bertrand in the chair.—M. Jamin presented the following paper in continuation of his researches on magnetism:—On the part played by the mean section, the polar surfaces, and the armatures of a magnet. The author concludes that the mean section *determines* the quantity, *and the* surface the *distribution*, of the magnetism.—Presentation of an ingot of 250 kilogrs. of platinum iridium alloy, cast at the Conservatoire des Arts et Métiers, May 13, 1874, by M. le Gen. Morin. This enormous ingot is more than 1 metre in length, and contains about 10·3 per cent. of iridium. It was fused in a furnace of limestone by means of an oxyhydrogen blow-pipe with seven jets, the *fusion being completed* in from 65 to 70 *minutes*.—M. Chevreul communicated a paper containing observations on M. Boussingault's paper on the transformation of iron into steel.—M. Boussingault made some remarks in reply, and MM. Dumas and Pasteur added some observations.—Observations on the dwarf African races, *à propos* of the photographs *of Akkas sent by Prof.* Panceri, by M. de Quatrefages.—Researches on the simultaneous diffusion of certain salts, by M. C. Marignac.—Probable decrease in the water supply from the Seine basin in the summer and autumn of 1874, by MM. E. Belgrand and G. Lemoine. The authors predict that the water supply will fall very low from now to the middle of October.—Memoir on the bay of St. Jean de Luz, by M. Bouquet de la Grye.—New process *for* engraving on *copper*, by *the same author*. The plate is first coated with a thin layer of silver, on which is spread a coloured varnish, and the design is then engraved with a dry point. The tracing is finally etched by a solution of ferric chloride.—Note on magnetism, by M. J. M. Gaugain. The present researches relate to the magnetisation of hardened steel.—On the motion of the air in pipes (fourth note), by M. Ch. Bontemps.—*On the adulteration* of bee's-wax with Japanese wax, by M. Ch. Mène. The author has determined the densities of the pure substances and of mixtures containing the two kinds of wax in varying proportions.—On the integrals of the differential equations of curves of which the locus of the centres of the intersecting ellipsoids, similar and similarly placed, is a given curve, by M. l'Abbé Aoust.—On a mechanical problem, by M. H. Durrande.—*On the principles of correspondence of* the plane and of space, by M. Zeuthen.—On the flatness of the planet Mars, by M. Amigues. The author arrives at the conclusion that the planet was formed in two or more stages and that the mean density of the superficial layers is 1·54 of the mean density of the nucleus.—On the shock of bodies (second note), by M. G. Darboux.—Perfection of electric chronographs, and researches on electro-magnets, by M. Marcel *Deprez.—Study of the products formed* by *the* action of hydrochloric acid on cast-iron and steel, by M. S. Cloez. The author has separated and made analyses of several hydrocarbons.—On the new triangulation of the Isle of Corsica, by M. F. Perrier.—Of the spectrum of muscle, by M. L. Ranvier. The author has devised an instrument called a *myospectroscope*, of which the action depends on the fact that striated muscular fibre when properly prepared acts as a *natural diffraction grating.—On certain* particulars of the history of casein and albumen *à propos* of a recent note by M. Commaille, by M. A. Béchamp.—Experiments which explain the difference of opinion on the constitution of the iron in the blood, by MM. Paquelin and L. Jolly.—On the *Tyroglyphus* of the vine, by M. A. Fumouze. This Acarus (*T. echinopus*) is stated by Planchon to destroy Phylloxera, but the author of the present *communication does not speak of it* hopefully as an agent of destruction of the vine scourge.—On a new indigenous genus of terrestrial Lombricians (*Pontodrilus marionis*), by M. E. Perrier.—On the mode of contagion of cholera, by M. Ch. Pellarin.

CONTENTS

PAGE
METEOROLOGY—PRESENT AND FUTURE 99
RECENT FRENCH GEOLOGICAL WORKS 100
OUR BOOK SHELF 102
LETTERS TO THE EDITOR:—
  The Habits of various Insects.—FRITZ MULLER 102
  Eozoon canadense—Dr. J. W. DAWSON, F.R.S. (*With Illustration*) 103
  Proportionality of Cause and Effect.—BRITISH QUARTERLY REVIEWER; ROBT. B. HAYWARD, A SENIOR WRANGLER, J. COLLIER 103
  The Glacial Period.—A. H. GREEN, F.G.S. 105
VENUS'S FLY-TRAP (*Dionæa muscipula*). By Dr. BURDON SANDERSON, F.R.S. 105
REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL," IV. (*With Illustrations*) 107
ON SPECTRUM PHOTOGRAPHY. By J. NORMAN LOCKYER, F.R.S. (*With Illustrations*) 109
THE CENTRAL PARK OF NEW YORK AND MR. WATERHOUSE HAWKINS 111
EUCALYPTUS GLOBULUS IN MAURITIUS. By JOHN R. JACKSON . . 112
COGGIA'S COMET. By J. R. HIND, F.R.S. 113
NOTES 113
SCIENTIFIC SERIALS 115
SOCIETIES AND ACADEMIES 116

THURSDAY, JUNE 18, 1874

PLATEAU ON SOAP-BUBBLES

Statique expérimentale et théorique des Liquides soumis aux seules Forces moléculaires. Par J. Plateau, Professeur à l'Université de Gand, &c. (Paris, Gauthier-Villars; London, Trübner & Co.; Gand et Leipzig, F. Clemm. 1873.)

ON an Etruscan vase in the Louvre figures of children are seen blowing bubbles. Those children probably enjoyed their occupation just as modern children do. Our admiration of the beautiful and delicate forms, growing and developing themselves, the feeling that it is *our* breath which is turning dirty soapsuds into spheres of splendour, the fear lest by an irreverent touch we may cause the gorgeous vision to vanish with a sputter of soapy water in our eyes, our wistful gaze as we watch the perfected bubble when it sails away from the pipe's mouth to join, somewhere in the sky, all the other beautiful things that have vanished before it, assure us that, whatever our nominal age may be we are of the same family as those Etruscan children.

Here, for instance, we have a book, in two volumes, octavo, written by a distinguished man of science, and occupied for the most part with the theory and practice of bubble-blowing. Can the poetry of bubbles survive this? Will not the lovely visions which have floated before the eyes of untold generations collapse at the rude touch of Science, and "yield their place to cold material laws"? No, we need go no further than this book and its author to learn that the beauty and mystery of natural phenomena may make such an impression on a fresh and open mind that no physical obstacle can ever check the course of thought and study which it has once called forth.

M. Plateau in all his researches seems to have selected for his study those phenomena which exhibit some remarkable beauty of form or colour. In the zeal with which he devoted himself to the investigation of the laws of the subjective impressions of colour, he exposed his eyes to an excess of light, and has ever since been blind. But in spite of this great loss he has continued for many years to carry on experiments such as those described in this book, on the forms of liquid masses and films, which he himself can never either see or handle, but from which he gathers the materials of science as they are furnished to him by the hands, eyes, and minds of devoted friends.

So perfect has been the co-operation with which these experiments have been carried out, that there is hardly a single expression in the book to indicate that the measures which he took and the colours with which he was charmed were observed by him, not in the ordinary way, but through the mediation of other persons.

Which, now, is the more poetical idea—the Etruscan boy blowing bubbles for himself, or the blind man of science teaching his friends how to blow them, and making out by a tedious process of question and answer the conditions of the forms and tints which he can never see?

But we must now attempt to follow our author as he passes from phenomena to ideas, from experiment to theory.

The surface which forms the boundary between a liquid and its vapour is the seat of phenomena on the careful study of which depends much of our future progress in the knowledge of the constitution of bodies. To take the simplest case, that of a liquid, say water, placed in a vessel which it does not fill, but which contains nothing else. The water lies at the bottom of the vessel, and the upper part, originally empty, becomes rapidly filled with the vapour of water. The temperature and the pressure—the quantities on which the thermal and statical relations of any body to external bodies depend—are the same for the water and its vapour, but the energy of a milligramme of the vapour greatly exceeds that of a milligramme of the water. Hence the energy of a milligramme of water-substance is much greater when it happens to be in the upper part of the vessel in the state of vapour, than when it happens to be in the lower part of the vessel in the state of water.

Now we find by experiment that there is no difference between the phenomena in one part of the liquid and those in another part except in a region close to the surface and not more than a thousandth or perhaps a millionth of a millimetre thick. In the vapour also, everything is the same, except perhaps in a very thin stratum close to the surface. The change in the value of the energy takes place in the very narrow region between water and vapour. Hence the energy of a milligramme of water is the same all through the mass of the water except in a thin stratum close to the surface, where it is somewhat greater; and the energy of a milligramme of vapour is the same all through the mass of vapour except close to the surface, where it is probably less.

The whole energy of the water is therefore, in the first place, that due to so many milligrammes of water; but besides this, since the water close to the surface has an excess of energy, a correction, depending on this excess, must be added. Thus we have, besides the energy of the water reckoned per milligramme, an additional energy to be reckoned per square millimetre of surface.

The energy of the vapour may be calculated in the same way at so much per milligramme, with a deduction of so much per square millimetre of surface. The quantity of vapour, however, which lies within the region in which the energy is beginning to change its value is so small that this deduction per square millimetre is always much smaller than the addition which has to be made on account of the liquid. Hence the whole energy of the system may be divided into three parts, one proportional to the mass of liquid, one to the mass of vapour, and the third proportional to the area of the surface which separates the liquid from the vapour.

If the system is displaced by an external agent in such a way that the area of the surface of the liquid is increased, the energy of the system is increased, and the only source of this increase of energy is the work done by the external agent. There is therefore a resistance to any motion which causes the extension of the surface of a liquid.

On the other hand, if the liquid moves in such a way that its surface diminishes, the energy of the system diminishes, and the diminution of energy appears in the form of work done on the external agent which allows the surface to diminish. Now a surface which tends to diminish in area, and which thus tends to draw together any solid framework which forms its boundary, is said to have surface-tension. Surface-tension is measured by the force acting on one millimetre of the boundary edge. In the case of water at 20° C., the tension is, according to M. Quincke, a force of 8·253 milligrammes weight per millimetre.

M. Plateau hardly enters into the theoretical deduction of the surface-tension from hypotheses respecting the constitution of bodies. We have therefore thought it desirable to point out how the fact of surface-tension may be deduced from the known fact that there is a difference in energy between a liquid and its vapour, combined with the hypothesis, that as a milligramme of the substance passes from the state of a liquid within the liquid mass, to that of a vapour outside it, the change of its energy takes place, not instantaneously, but in a continuous manner.

M. van der Waals, whose academic thesis, "Over de Continuiteit van den Gas- en Vloeistoftoestand,"* is a most valuable contribution to molecular physics, has attempted to calculate approximately the thickness of the stratum within which this continuous change of energy is accomplished, and finds it for water about 0·0000003 millimetre.

Whatever we may think of these calculations, it is at least manifest that the only path in which we may hope to arrive at a knowledge of the size of the molecules of ordinary matter is to be traced among those phenomena which come into prominence when the dimensions of bodies are greatly reduced, as in the superficial layer of a liquid.

But it is in the experimental investigation of the effects of surface-tension on the form of the surface of a liquid that the value of M. Plateau's book is to be found. He uses two distinct methods. In the first he prepares a mixture of alcohol and water which has the same density as olive oil, then introducing some oil into the mixture and waiting till it has, by absorption of a small portion of alcohol into itself, become accommodated to its position, he obtains a mass of oil no longer under the action of gravity, but subject only to the surface-tension of its boundary. Its form is therefore, when undisturbed, spherical, but by means of rings, disks, &c., of iron, he draws out or compresses his mass of oil into a number of different figures, the equilibrium and stability of which are here investigated, both experimentally and theoretically.

The other method is the old one of blowing soap-bubbles. M. Plateau, however, has improved the art, first by finding out the best kind of soap and the best proportion of water, and then by mixing his soapy water with glycerine. Bubbles formed of this liquid will last for hours, and even days.

By forming a frame of iron wire and dipping it into this liquid he forms a film, the figure of which is that of the surface of minimum area which has the frame for its boundary. This is the case when the air is free on both sides of the film. If, however, the portions of air on the two sides of the film are not in continuous communication, the film is no longer the surface of absolute minimum area, but the surface which, with the given boundary, and inclosing a given volume, has a minimum area.

M. Plateau has gone at great length into the interesting but difficult question of the conditions of the persistence of liquid films. He shows that the surface of certain liquids has a species of viscosity distinct from the interior viscosity of the mass. This surface-viscosity is very remarkable in a solution of saponine. There can be no doubt that a property of this kind plays an important part in determining the persistence or collapse of liquid films. M. Plateau, however, considers that one of the agents of destruction is the surface-tension, and that the persistence mainly depends on the degree in which the surface-viscosity counteracts the surface-tension. It is plain, however, that it is rather the inequality of the surface-tension than the surface-tension itself which acts as a destroying force.

It has not yet been experimentally ascertained whether the tension varies according to the thickness of the film. The variation of tension is certainly insensible in those cases which have been observed.

If, as the theory seems to indicate, the tension diminishes when the thickness of the film diminishes, the film must be unstable, and its actual persistence would be unaccountable. On the other hand, the theory has not as yet been able to account for the tension increasing as the thickness diminishes.

One of the most remarkable phenomena of liquid films is undoubtedly the formation of the black spots, which were described in 1672 by Hooke, under the name of holes.

Fusinieri has given a very exact account of this phenomenon as he observed it in a vertical film protected from currents of air. As the film becomes thinner, owing to the gradual descent of the liquid of which it is formed, certain portions become thinner than the rest, and begin to show the colours of thin plates. These little spots of colour immediately begin to ascend, dragging after them a sort of train like the tail of a tadpole. These tadpoles, as Fusinieri calls them, soon begin to accumulate near the top of the film, and to range themselves in horizontal bands according to their colours, those which have the colour corresponding to the smallest thickness ascending highest.

In this way the colours become arranged in horizontal bands in beautiful gradation, exhibiting all the colours of Newton's scale. When the frame of the film is made to oscillate, these bands oscillate like the strata formed by a series of liquids of different densities. This shows that the film is subject to dynamical conditions similar to those of such a liquid system. The liquid is subject to the condition that the volume of each portion of it is invariable, and the motion arises from the fact that by the descent of the denser portions (which is necessarily accompanied by the rise of the rarer portions) the gravitational potential energy of the system is diminished. In the case of the film, the condition which determines that the descent of the thicker portions shall entail the rise of the thinner portions must be that each portion of the film offers a special resistance to an increase or diminution of area This resistance probably forms a large part of the superficial viscosity investigated by M. Plateau, which retards the motion of his magnetic needle, and evidently is far greater than the viscosity of figure, in virtue of which the film resists a shearing motion.

The coloured bands gradually descend from the top of the film, presenting at first a continuous gradation of colour, but soon a remarkable black, or nearly black, band begins to form at the top of the film, and gradually to extend itself downwards. The lower boundary of this black band is sharply defined. There is not a continuous gradation of colour according to the arrangement in Newton's table, but the black appears in immediate contact with the white or even the yellow of the first order, and M. Fusinieri has even observed it in contact with bands of the third order.

---

* Leiden, A. W. Sijthoff, 1873.

Nothing can show more distinctly that there is some remarkable change in the physical properties of the film, when it is of a thickness somewhat greater than that of the black portion. And in fact the black part of the film is in many other respects different from the rest. It is easy, as Leidenfrost tells us, to pass a solid point through the thicker part of the film, and to withdraw it, without bursting the film, but if anything touches the black part, the film is shattered at once. The black portion does not appear to possess the mobility which is so apparent in the coloured parts. It behaves more like a brittle solid, such as a Prince Rupert's drop, than a fluid. Its edges are often very irregular, and when the curvature of the film is made to vary, the black portions sometimes seem to resist the change, so that their surface has no longer the same continuous curvature as the rest of the bubble. We have thus numerous indications of the great assistance which molecular science is likely to derive from the study of liquid films of extreme tenuity.

We have no time or inclination to discuss M. Plateau's work in a critical spirit. The directions for making the experiments are very precise, and if sometimes they appear tedious on account of repetitions, we must remember that it is by words, and words alone, that the author can learn the details of the experiment which he is performing by means of the hands of his friends, and that the repetition of phrases must in his case take the place of the ordinary routine of a careful experimenter. The description of the results of mathematical investigation, which is a most difficult but at the same time most useful species of literary composition, is a notable feature of this book, and could hardly be better done. The mathematical researches of Lindelof, Lamarle, Scherk, Riemann, &c., on surfaces of minimum area, deserve to be known to others besides professed mathematicians, and M. Plateau deserves our thanks for giving us an intelligible account of them, and still more for showing us how to make them visible with his improved soap-suds.

In the speculative part of the book, where the author treats of the causes of the phenomena, there is of course more room for improvement, as there always must be when a physicist is pushing his way into the unknown regions of molecular science. In such matters everything human, at least in our century, must be very imperfect, but for the same reason any real progress, however small, is of the greater value. J. CLERK MAXWELL

HINTON'S PRACTICAL PHYSIOLOGY

Physiology for Practical Use. By various writers. Edited by James Hinton. 2 vols. (Henry S. King & Co.)

THIS work consists of a series of independent essays by different writers, on points in physiology which are likely to prove interesting and instructive to the general public. No attempt is made to give more than the best known facts of the science, together with the most approved theories by which they are, at the present day, connected. The thoroughness of the knowledge of the authors, the largeness of the view they take of the subject, and the easiness of the style they adopt add greatly to the interest of the book.

Those who are accustomed to regard the living body as an arrangement of organs which is quite peculiar and whose mechanism is altogether inexplicable upon the ordinary principles of mechanics and chemistry, will, after having carefully studied this work, be convinced how subject it is to the same influences that affect the inanimate world, and that in fact it is nothing more than a very complex machine, with the detailed mechanism of which we are daily becoming more and more acquainted. There are peculiarities however in the living frame which fail to be represented in working out the analogy with the steam engine. "The latter, after being constructed, daily wastes. Every day it becomes worse, for each stroke of its piston, to say nothing of the motion of its other parts, implies a waste of the piston itself, and of the cylinder in which it is inclosed, and in which it works. Now when we get these out of order, the whole machine has to be stopped, that the engineer may repair the deteriorated portions." Such is not the case in the living body, which differs from any machine yet constructed in that it is "constantly working, constantly wasting, and *constantly repairing its own deficiencies.*" This is a most important difference between the two engines; and it is almost certain, that as our knowledge of machine-construction increases, but little improvement will ever be made in this direction, on account of the nature of the materials employed, so that the difference will not be diminished. The cell of a Daniel's battery may be instanced as an example of an engine in which a partial repair of its structure is continually being effected, for by the gradual solution of the crystals of sulphate of copper that are always placed in one of the compartments, the power of the battery, and therefore the constancy of the current it developes is rendered more perfect.

There is an excellent chapter on alcohol, in which the principle of its action is most clearly explained. The author prefaces his subject by clearly stating his views on its social relations. For instance, he remarks:—"We are not in the ranks of those who would remove the tax on spirits, a tax whereby the poor as well as the rich are made to contribute to the expenses of Government, by paying a price above its production-cost for an article of luxury; and very far are we from siding with those who misinterpret the liberty of the subject—we mean the right of any man to wrong his neighbour, to sell him fictitious goods—poison, perchance for food." . . . "We are not abstainers ourselves, and we are not about to advocate teetotalism under the banner of physiological instruction."

There is a paragraph which quite represents the generally accepted doctrine of the relation of mental activity to work done, but to which we think all physiologists ought now-a-days to take exception. It is remarked that "energy, the manifestation of power, or the conversion of force into action, involves no expenditure of life or loss of power. Thinking or lifting a weight is but a function of tissues provided to issue thoughts or actions. The tissues do not suffer by reason of their employment, so long as their nutrition is maintained. Brain and muscle can be very fairly likened to machinery." From this it is evident that the author considers that both mental and muscular activity involve a consumption of nutriment material according to their amount. Of muscular action this is no doubt correct, for the amount of work performed can be measured by foot-pounds without difficulty; but as it is inconceivable that we should be able to say that one pound falling through one foot is equivalent to so much thought, or so much of an argument, not because of the difficulty in measuring, but because of the total absence of relation between the one and the other; so it is necessary to believe that thought is not a mode of motion, is not capable of being correlated with the other physical forces, and does not involve the consumption of nutrient fluid. If the brains of different individuals are compared to running streams, in which the waters exhibit different degrees of clearness, as brains give evidences of differences in quality, their thoughts may be compared to the reflections of surrounding objects on the surfaces of the streams, different in intensity according to the clearness of the water or the quality of the brain cells. Upon this analogy it is evident that the relative intensity of different reflections is not dependent at all on the stream itself, but on the illuminating power of the objects reflected; in like manner we cannot conceive that the amount of nerve tissue disintegrated by the greatest minds at the time that they are evolving their mightiest thoughts is in excess of that which is wasted during the same time by the most commonplace member of every community. Thought is as intimately connected with the reception of external impressions by the healthy human brain as reflections from water are with the illumination of the surrounding objects; they are involuntary when cause for their development is present.

The chapters on headache and on sleep are amongst those which show how backward is our knowledge of some of the simplest of the phenomena of life. We may be able to recognise that "sick headache" and nightmare have something to do with the presence of indigestible matter in the stomach, but as to the true relation between the two we are still completely in the dark. In speaking of "taking cold" the author tells us that "cold contracts almost all substances, and when the skin is exposed to its influence the contraction becomes visible to the eye, and the appearance it presents is called *goose-skin*, from its resemblance to the natural condition of the skin of the goose." This will, we fear, mislead those readers who are pure physicists as to what is the index of expansion of skin for heat, the fact being that the cold, by stimulating the small arteries of the corium, causes them to contract, and so prevents the blood from entering its substance, which gives it the shrunken, plucked-bird-like appearance that it presents. We are told also that "no danger need ever be apprehended from the application of cold water . . . to the naked body, if it be made immediately after remaining some time exposed to a high temperature." With this it is difficult to agree, for the epistaxis, or nose-bleeding, which sometimes occurs on entering the cold plunge of the Turkish bath shows that the blood-pressure is thereby suddenly augmented to a degree which cannot but be dangerous in some cases, especially when the walls of the arterial system are not as strong as they might be.

In conclusion we strongly recommend this work to non-professional readers, from the lucid and logical manner in which the physiological problems of everyday life are stated. The public cannot be too forcibly impressed with the importance of removing causes rather than combating effects by direct means, and on these points the authors lay considerable stress. The principles of such subjects as ventilation and gymnastics cannot be too frequently taught, and when expounded by writers so capable as those of the work before us they are doubly impressive.

OUR BOOK SHELF

Annual Record of Science and Industry for 1873. Edited by Spencer F. Baird, with the assistance of eminent men of Science.—(New York: Harper and Brothers, 1874.)

The Year Book of Facts in Science and Art: exhibiting the most important discoveries of the past year. By John Timbs.—(London: Lockwood and Co., 1874.)

THESE books, like M. Figuier's "L'Année scientifique," give a fair general idea of the progress of Science and the mechanical arts during the year. They are scarcely sufficiently comprehensive and exact for the man of Science, but are decidedly useful for the ordinary well-educated reader, who takes an interest in the discoveries of Science. Mr. Baird's book is perhaps something more than this: it is carefully arranged, and enters into detail in most cases; it is also preceded by a "General Summary of Scientific Progress," of somewhat more than a hundred pages. From this we learn that five new planets were discovered during 1873—the last "Sophrosyne" being the 134th in order, starting from "Ceres," which was discovered in 1801. Seven comets were seen during last year, three of them new ones; five out of the seven were first seen in Marseilles by those indefatigable observers, Stephan, Coggia, and Borelli. In Physics there appears to have been no discovery of any particular note. In Chemistry the copper-zinc couple of Dr. Gladstone and Mr. Tribe, and its results are described as among the most interesting work of the year. Further on we find an account of the cruise of the *Challenger*, and favourable mention of Sir William Thomson's suggestions that steel pianoforte-wire should be used for a sounding line in place of the usual hempen cord, which offers far greater resistance, and requires a heavy weight at the bottom. Under the head of "Mechanics and Engineering," we find some interesting statistics of American iron-industry. The production of pig-iron in the United States is estimated (for 1873) at 2,406,637 gross tons. The total number of furnaces is 636, and their estimated capacity 4,371,277 net tons. There are eight Bessemer works in the country, with a total capacity of 170,000 tons. The great Hoosac tunnel, 4¾ miles long, was completed during the year. In Timbs' "Year Book" we find too many evidences of careless compilation, and great want of method in grouping the different subjects. We read, "Dr. Odling, President of the Chemical Society, read a paper On the preparation of the Standard Trial plates to be used in verifying the composition of the coinage:'"—the paper was by Mr. Roberts, not Dr. Odling. Among the so-called chemical subjects, we find "Sunlight for the sick," "Transparent paper," and "Opium-smoking in New York." It is unfortunate also that non-scientific journals are so often made to guarantee scientific facts.

The *Illustrated London News* is quoted, and the *Hampshire Telegraph* is made to paraphrase the *Philosophical Magazine.*

Reprint of Boddaert's Table des Planches Enluminces d'Histoire Naturelle. Edited by W. B. Tegetmeier, F.Z.S.

MR. TEGETMEIER has done a service to ornithology by increasing the facilities for precise avian nomenclature, in reprinting, with an accuracy in typography which does him much credit, a catalogue compiled by Dr. Boddaert, printed in 1783, which contains the names of a large number of birds, given on the then novel binomial system of Linnæus. The original work is extremely scarce, only two copies being known in the United Kingdom; and as so much stress has to be laid on priority in naming, a book published so soon after the tenth edition of the "Systema Naturæ" ought to be available to all working ornithologists.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Molecular Motion

IN Prof. Maxwell's communication, NATURE, vol. viii., p. 537, on this subject, he assumes that if n_1 represent the number of molecules of a particular kind in a given element of space with a velocity given in direction and magnitude, which we will call v_1; and if n_2 represent the particles of another kind in the same element with the velocity v_2, then the number of encounters of these particles is proportional to $n_1 \times n_2$, and if out of these we select the particular encounters which give rise to a given set of resultant velocities v_1' and v_2', then we may assume that if the number of particles in the element which originally had the velocities v_1' and v_2' be called n_1' and n_2', then

$$n_1 n_2 = n_1' n_2'$$

This reasoning does not seem convincing. Assuming that in an element of space the average number of particles having a given velocity is the same, so that n_1 and n_2 are *not* functions of v_1 and v_2, then Mr. Maxwell's statement might be admitted; but if the number of particles in a given element is a function of its velocity in direction and magnitude, then although the average of the numbers in each direction is maintained, it does not follow that the average numbers of particles having the velocities v_1 and v_2 are directly restored from the particles having the velocities v_1' and v_2'. All that can be assumed is, that the average number of particles in a given element of space is maintained from the particles in that and the remaining elements. Just as in the case of an equilibrium of trade, the average course of exchange with respect to a given country is at par; but we cannot therefore safely assume that the same is the case relatively to any other individual country.

There are several other points in Mr. Maxwell's communication which seem to me to require fortification, but the subject has already assumed so technical a form that it would perhaps be uninteresting to your readers to point them out. My impression is that the whole subject is still somewhat beyond the grasp of strict mathematical reasoning, and is still open to experimental investigation.

F. GUTHRIE

Graaff Reinet College, Feb. 7

[This question is treated at length in my paper On the dynamical theory of gases (Phil. Trans., 1866). It is there shown that if the average course of exchange is in a cycle from A to B, B to C, C to A, an equal reason may be given why it should be in the opposite cycle A to C, C to B, B to A., and thus it is shown that the exchange is at par between each pair of states separately. For a far more elaborate theoretical treatment of the subject Prof. Guthrie is referred to the papers of Prof. Ludwig Boltzmann in the Vienna Transactions since 1868. I fear we must delay the experimental investigation for some time, till we are able to count the molecules in a given space, to observe their velocities, and to repeat these operations millions of times in a second.—J. CLERK MAXWELL.]

The Germans and Physical Axioms

ALTHOUGH the *à priori* origin of the fundamental principles of Mechanics has been lucidly demonstrated by the reasoning of Herbert Spencer, it is presumable that his antagonists, who evidently pay great deference to authority, will not be convinced of its truth except by the opposition of acknowledged authorities. Kant, in Germany, one of the first and most assiduous students of Newton's *Principia*, from which he derived the nebular hypothesis subsequently developed by Laplace, thus delivers himself respecting the matter under discussion:—

"The science of Natural Philosophy (Physics) contains in itself synthetical judgments *à priori as principles*. For instance, the proposition, 'in all changes of the material world, the quantity of matter remains unchanged;' or, that 'in all communication of motion, action and reaction must always be equal.' In both of these, not only is the *necessity, and therefore their origin à priori clear*. . . . And so it is with regard to the other propositions of the pure part of Natural Philosophy."—"Critique of Pure Reason," Bohn's edition, page 11 of Introduction:—

This is explicit and incontrovertible. Yet those with whom precedents are omnipotent may argue that, since Kant was preeminent as a metaphysician rather than as a physicist, his deliverances must fall before the contrariety of such a man as Prof. Tait. Read then, the declaration of Helmholz:—

"In mathematics the general propositions which, under the name of axioms, stand at the head of the reasoning, are so few in number, so comprehensive, and so immediately obvious, that no proof whatever is needed for them. Let me remind you that the whole of algebra and arithmetic is developed out of the three axioms—

'Things which are equal to the same things are equal to one another.'

'If equals be added to equals, the wholes are equal.'

'If unequals be added to equals, the wholes are unequal.'

"And the axioms of geometry and *mechanics* are not more numerous. The sciences we have named are developed out of these few axioms by a continual process of deduction from them in more and more complicated cases."—Lecture "On the Relation of Natural Science to General Science."

Of course neither of these attestations is elucidatory, but they suffice to show that in Germany, at least, the axiomatic nature of physical principles is beyond controversy.

Waterbury, Conn., U.S. CHAS. G. ROOT

The Long Peruvian Skull

A KIND correspondent has called my attention to a communication from Dr. Daniel Wilson, of Toronto, in NATURE, vol. x. p. 46, to which my friend considers it incumbent upon me to reply. The communication in question has now reached me, although so late, but I can hardly regard it as requiring any answer, since I am quite satisfied my friend Dr. Wilson in it answers himself. As to his logical arguments, based upon Prof. Wyman's suggestion, that in Dr. Wilson's estimation *the skulls are natural because they are symmetrical*, no one can doubt that Dr. Wilson is fully acquainted with the want of symmetry in a large number of crania of all races. Of this it was scarcely needful for Dr. Wilson to reassure us.

But in reply to the real question at issue, had the ancient Peruvians dolichocephalic or long skulls, as well as brachycephalic, or short skulls? This question I must regard as fully solved, and I look upon it that craniologists consider this race to be brachycephalic. How is it, then, that Dr. Wilson, who has paid great attention to the study of craniology, maintains that there were among the ancient Peruvians two distinct types, a dolichocephalic and a brachycephalic section? A reference to his "Prehistoric Man," the two editions of which lie before me on the table, will suffice to indicate the source of error. I will refer to the figures which are unequivocal. In the first edition of this work, Dr. Wilson gives, Fig. 59, p. 240, vol. ii., the wood-cut of a Peruvian dolichocephalic skull, as an instance of the long skull type natural to the ancient Peruvians. At p. 242 he gives, "Fig. 60.—A Peruvian Child's Skull, Normal." This is the woodcut repeated in NATURE, vol. x. p. 48, Fig. 3. Seeing that both these skulls bore unequivocal marks of artificial distortion, years ago I acquainted Dr. Wilson with this fact, when I understood him to reply that the printer had not put the proper figures in the right places. When the second edition of "Prehistoric Man" reached me I looked to see if the right cuts had got put into their proper places, but was surprised to find that at p. 446 the former figure is repeated with the description, "Fig. 58.—Peruvian Depressed Skull." This is quite correct, for it is not only depressed, but depressed by art; therefore it cannot be an instance of a natural Peruvian dolichocephalic skull. But at p. 451 the latter woodcut is repeated as "Fig. 60.—Peruvian Child's Skull, Normal," and described as such. Indeed it is not necessary to go beyond Dr. Wilson's communication to NATURE. His Fig. 3, p. 48, is the identical woodcut, as "Peruvian Child's Skull Normal." This woodcut is quite conclusive as to what I have asserted, that Dr. Wilson has answered himself. For it is the calvarium of a child which has been artificially distorted and thereby elongated. And in truth it is only necessary to cast the eye on the figures upon the same page in NATURE to see that all the skulls, Figs. 1, 3, and 4, have all been distorted, and distorted in the same manner, viz. by a figure of 8 bandage, which has left its distinct impressions upon the frontal, parietal, and occipital bones. This distortion has necessarily converted them into dolichocephalic or long skulls, in contradistinction to their natural form, which is exhibited in Fig. 2, on the same page of NATURE. This bandage has been the instrument of distortion, and all three have been deformed in what I call the *cylindroidal* manner, resulting in the lengthening out of the calvarium. It may be observed that this mode of distortion is the most generally diffused of any among human races, both of the old world and the new. The figures differ only in the degree of deformation, the "Fig. 3.—Peruvian Child's Skull, Normal," having been less tightly compressed than the other two. I conclude that it is quite unquestionable that this Peruvian skull cannot be looked upon as a natural Peruvian skull, cannot be adduced as evidence that there was a second type of cranium among the ancient Peruvians. The best inspection I am able to give the figures proves this unequivocally, and I am bound to affirm, with the utmost respect to Dr. Daniel Wilson, that he has fully answered himself, and proved that the asserted long Peruvian skulls are simply crania artificially contorted into dolichocephalic ones. After this it may be very safely said that craniologists, beginning with Morton, and going on to that eminent and accurate anatomist, Prof. J. Wyman, are agreed that the ancient Peruvian race was distinguished by having brachycephalic skulls, as is shown in Dr. Wilson's "Fig. 2.—Peruvian Child's Skull, Santa," NATURE, vol. x. p. 48, which is simply an undistorted and natural example.

Having said this, which is a plain statement of what I believe to be the truth, I may add that I regret to find scientific questions are by some even who have acquired a reputation treated as a source of wrangling (I do not at all allude to Dr. Wilson), which I observe with much regret; but such course I most certainly shall not imitate. If a plain statement of facts does not convince, I shall not try any other method. When Dr. D. Wilson shall produce half a score of ancient Peruvian dolichocephalic skulls, the appearance of which totally precludes the possibility of interference by art or other deforming accident, then the question he introduces will be open for discussion, but, until then, I hold that there is no valid reason to doubt that the ancient Peruvians were a decidedly brachycephalic race.

J. BARNARD DAVIS

IN NATURE, (vol. x. p. 46), Prof. Daniel Wilson replies to criticisms by Dr. J. Barnard Davis and myself, of his conclusion that certain skulls, described and figured in "Prehistoric Man," and belonging to the collections of Dr. Warren, of Boston, had natural and not artificial forms. As far as I am concerned, he quotes from a letter of mine to Dr. Davis the following sentence:—

"The upshot of the whole is the crania do not confirm Dr. Wilson's statement. One of Dr. Wilson's chief points—in fact it is his chief point—is, that the skulls are natural because they are symmetrical, and it is next to impossible that a distorted skull should be symmetrical."

In this sentence he says I misrepresent him, and appeals to his published views with regard to asymmetry in skulls in general, about which I had said nothing. I was writing only of those particular ones represented in Figs. 1 and 3 of Prof. Wilson's article in NATURE, and Figs 59 and 60 in "Prehistoric Man." In justification of the paragraph from my letter given above, and to which he objects as unfair, I quote the following sentence from "Prehistoric Man," pp. 449-50:—

"Few who have had extensive opportunities of minutely examining and comparing normal and artificially formed crania will, I think, be prepared to dispute the fact *that the latter are rarely if ever symmetrical*. The application of pressure on the head of the living child can easily be made to change its natural contour, *but it cannot give to its artificial proportions that harmonious repetition of corresponding developments on opposite sides* which may be assumed as the normal condition of the unmodified cranium. But in so extreme a case as the conversion of a brachycephalic head averaging about 6·3 in longitudinal diameter, *the retention of anything like normal symmetrical proportions is impossible*. Yet the dolichocephalic Peruvian crania present no such abnormal irregularities as could give countenance to the theory of their form being an artificial one."

I will only add, that in several distorted dolichocephalic Peruvian crania in the collections of the Peabody Museum at Cambridge, the symmetry is as complete as in any ordinary undistorted crania.

JEFFRIES WYMAN

Cambridge, Mass., U.S.

Lakes with two Outfalls

FIFTY miles south of Denver, Colorado Territory, on the Denver and Rio Grandé R.R., there is a little lake with two outfalls, which I have myself seen. This lake is on an east and west "divide" and is 8,000 ft. above sea-level; the outfall to the north, Plum Creek, goes to the Platte River, while Monument Creek, to the south, flows into the Arkansas.

EDWARD S. HOLDEN

Naval Observatory, Washington, U.S., June 2

CAPT. J. D. COCHRANE, R.N., in his "Narrative of a Pedestrian Journey through Russia and Siberian Tartary, &c., in the years 1820-23," has the following reference. I quote from the American edition (1824), p. 235:—

"In the evening we reached a fertile spot, and halted on the banks of a lake, from which, it is said, the rivers Okota and Koudouson, running in counter directions, have their source, a circumstance which recalled to my recollection those words in an able work by Mr. Barrow upon rivers, wherein it is said that, although it is not a physical impossibility that two rivers should flow in opposite, or indeed in any direction out of the same lake, yet the contrary approaches so near to an axiom in geography that no instance is perhaps known of such an occurrence."

The rivers named flow respectively into the Sea of Okhotsk and the Arctic Sea. Perhaps a reference to other and later works may settle the question whether this lake has two outlets.

Chicago, U.S., June 2

S. W. BURNHAM

Palæotherium magnum

THE *Palæotherium magnum*, an account of the discovery of which appeared in NATURE, vol. ix. p. 285, differs in so many respects from that which was restored by Cuvier, that it may be well, if possible, to try and reconcile these two accounts.

Cuvier, in his "Ossemens fossiles" (1825) after taking the individual bones of the *Palæotherium* one by one, and considering their affinities, places them together, and restores from them as far as possible the animals to which they belonged.

In vol. ii. p. 163, he says: "Hence we see in our environs of Paris, and elsewhere, the genus *Palæotherium*, which resembles the tapirs by its incisor and canine teeth, and in that the nasal bones are so arranged as to carry a trunk, whilst the molars more nearly approximate to those of the rhinoceros and deer."

In vol. iii. p. 53, *et seq.* he commences with a description of the skull, and passes on to the other bones in order.

Having considered separately the various bones of the eight species which he describes, he passes on at p. 243 to the restoration of the whole skeleton, considering first that one of which he had the most perfect remains, viz. *Palæotherium minus*, *vide* vol. iii., pl. 34. This skeleton is a more perfect specimen in many ways than that which was discovered the other day, though a good part of the lower extremities are wanting.

Speaking of this specimen Cuvier says (vol. iii., p. 244): "If only we could bring this animal to life as easily as we have put together its bones, we should see running about a tapir smaller than a roebuck, with thin and slender legs." And again, "Its height to the withers would be from 16 to 18 in."

This skeleton, it will be seen, resembles to a great extent that of *Palæotherium magnum*, which was figured in NATURE, vol. ix. p. 286. Having completed the smaller animal, *P. magnum* is next considered, of which Cuvier says: "We have the head and four extremities of this animal; by supplying it with a body like that of its predecessor, it will be very easy to restore its skeleton. Its head and limbs may be seen at pl. 49, 50, and 60, and its restoration at pl. 66, resembling almost exactly that of

P. minus, though the former is much the larger. Such then are the facts as they appear from Cuvier's writings. The fact that this one skeleton of *P. minus* was found with the neck in the erect position may have been considered by Cuvier as hardly a sufficient reason for placing the neck of his restored specimen, which showed so many tapiroid peculiarities, in the same position. Now, however, that a second skeleton of a *Palæotherium* has been found, with the neck in a similar position, the probability that such a position is the natural one is immensely enhanced.

Two points, however, remain somewhat involved in obscurity; first, how is it that the skeleton of *P. magnum*, as found at Vitry-sur-Seine the other day, differs so much in the length of its leg-bones from the *P. magnum* of Cuvier, which it undoubtedly does if the drawings and descriptions of both are correct? and secondly, how was it that Cuvier, with such a perfect skeleton as that in the accompanying figure, should restore an animal with such short and comparatively stout legs?

Someone perhaps may be able to throw some light upon these points.

W. BRUCE-CLARKE

The Telegraph in Storm-warnings

THE idea of using the electric telegraph to give warning of cyclones approaching from a distance is generally supposed to have first occurred to Prof. Henry of the Smithsonian Institution in 1847 (NATURE, vol. iv. p. 390). This however is not the fact, for the same thing had been recommended in India fully five years before by the late Mr. Henry Piddington, in his sixth "Memoir on the Law of Storms," published in the Journal of the Asiatic Society of Bengal in 1842. Referring to a storm which was tracked from Macao to Shih-poo, and its estimated rate of travelling, he says (p. 703):—"If China was a country under European dominion, a telegraph might, when these storms strike the eastern coast, warn those on the southern that they were coming, and in India we might often attain the same advantage. *Our children may see this done.*" In 1849, when he published the first edition of his "Sailor's Horn-Book for the Law of Storms," he had not yet heard of the fulfilment in America of his prophecy, which however he has duly noticed in subsequent editions.

FRED. NORGATE

Corydalis claviculata

A SHORT additional note on *Corydalis claviculata* may be of interest. A sprig placed in a glass of water and out of the way of insects continues to grow and to bear flowers and fruit with nearly as much regularity as if still rooted to its native bank. The flowers do not gape spontaneously; and, as most of the older ones that I have examined in a state of nature have their lips depressed, I think it certain evidence of the agency of insects, though I have not yet been so fortunate as to witness their operations. All the flowers that I have seen are of a greenish white, but dried specimens acquire the yellow tint described in systematic works, a fact which may help to throw light on the somewhat parallel behaviour of *Fumaria pallidiflora*.

Kilderry, co. Donegal W. E. HART

POLARISATION OF LIGHT*

IX.

THE results of combining two or more colours of the spectrum have been studied by Helmholtz, Clerk-Maxwell, Lord Rayleigh, and others. And the combinations have been effected sometimes by causing two spectra at right angles to one another to overlap, and sometimes by bringing images of various parts of a spectrum simultaneously upon the retina. Latterly also W. von Bezold has successfully applied the method of binocular combination to the same problem (*Poggendorff*, Jubelband, p. 585). Some effects, approximating more or less to these, may be produced by chromatic polarisation.

Complementary Colours.—First, as regards complementary colours. If we use a Nicol's prism N as polariser, a plate of quartz Q cut perpendicularly to the axis, and a double-image prism P as analyser, we shall, as is well known, obtain two images whose colours are complementary. If we analyse these images with a prism, we shall find when the quartz is of suitable thickness, that each spectrum contains a dark band indicating the extinction of a certain narrow portion of its length. These bands will simultaneously shift their position when the Nicol N is turned round. Now, since the colours remaining in each spectrum are complementary to those in the other, and the portion of the spectrum extinguished in each is complementary to that which remains, it follows that the portion extinguished in one spectrum is complementary to that extinguished in the other. And in order to determine what portion of the spectrum is complementary to the portion suppressed by a band in any position we please, we have only to turn the Nicol N until the band in one spectrum occupies the position in question, and then to observe the position of the band in the other spectrum. The combinations considered in former experiments are those of simple colours; the present combinations are those of mixed tints, viz. of the parts of the spectrum suppressed in the bands. But the mixture consists of a prevailing colour corresponding to the centre of the band, together with a slight admixture of the spectral colours immediately adjacent to it on each side.

The following results given by Helmholtz, may be approximately verified:—

Complementary Colours	
Red	Green-blue
Orange	Cyanic blue
Yellow	Indigo-blue
Yellow-green	Violet

When in one spectrum the band enters the green, in the other a band will be seen on the outer margin of the red, and a second at the opposite end of the violet; showing that to the green there does not correspond one complementary colour, but a mixture of violet and red, *i.e.* a reddish purple.

Combination of two Colours.—Next as to the combination of two parts of the spectrum, or of the tints which represent those parts. If, in addition to the apparatus described above, we use a second quartz plate Q_1 and a second double-image prism P_1, we shall form four images, say O O, O E, E O, E E. And if A, A′ be the complementary tints extinguished by the first combination Q P alone, and B, B′ those extinguished by the second Q_1 P_1 alone, then it will be found that the following pairs of tints are extinguished in the various images.

Image	Tints extinguished
O O	B, A
O E	B′, A′
E O	B′, A
E E	B, A′

It is to be noticed that in the image O E the combination Q_1 P_1 has extinguished the tint B′ instead of B, because the vibrations in the image E were perpendicular to those in the image O formed by the combination Q P. A similar remark applies to the image E E.

The total number of tints which can be produced by this double combination Q P, Q_1 P_1 is as follows:—

4 single images
6 overlaps of two
4 overlaps of three
1 overlap of four
—
Total, 15

Collateral Combinations.—The tints extinguished in the overlap O O + E O will be B, A, B′, A; but since B and B′ are complementary, their suppression will not affect the resulting tint except as to intensity, and the overlap will be effectively deprived of A alone; in other words, it will be of the same tint as the image O would be if the combination Q_1 P_1 were removed. Similarly the overlap O E + E E will be deprived effectually of A′ alone; in other words, it will be of the same tint as E, if Q_1 P_1 were removed. If therefore the Nicol N be turned round, these two overlaps will behave in respect of colour exactly as did the images O and E when Q P was alone used. We may, in fact, form a table thus:—

---

* Continued from vol. ix. p 508.

Image	Colours extinguished
O O + E O	$B + A + B' + A = B + B' + A = A$
O E + E E	$B' + A' + B + A' = B + B' + A' = A'$

And since the tints B, B′ have disappeared from each of these formulæ, it follows that the second analyser P may be turned round in any direction without altering the tints of the overlaps in question.

In like manner we may form the Table—

O O + E E	$B + A + B + A' = B + A + A' = B$
O E + E O	$B' + A' + B' + A = B' + A + A' = B'$

Hence if the Nicol N be turned round, these overlaps will retain their tints; while if the analyser P_1 be turned, their tints will vary, although always remaining complementary to one another.

There remains the other pair of overlaps, viz.:—

O O + O E	$B + A + B' + A$
E O + E E	$B' + A + B + A'$

Each of these is deprived of the pair of complementaries A, A′, B, B′; and therefore each, as it would seem, ought to appear white of low illumination, *i.e.* grey. This effect is, however, partially masked by the fact that the dark bands are not sharply defined like the Fraunhofer lines, but have a core of minimum or zero illumination, and are shaded off gradually on either side until a short distance from the core the colours appear in their full intensity. Suppose, for instance, that B′ and A′ were bright tints, the tints resulting from their suppression would be bright. On the other hand, the complementary tints A and B would be generally dim, and the image B + A bright, and the overlap B + A + B′ + A′ would have as its predominating tint that of B + A. And similarly in other cases.

There are two cases worth remarking in detail, viz. first, that in which

$$B = A',\ B' = A$$

i.e. when the same tints are extinguished by the combination Q P and by $Q_1 P_1$. This may be verified by either using two similar quartz plates Q, Q_1; or by so turning the prism P_1 that the combination $Q_1 P_1$ used alone shall give the same complementary tints as Q P when used alone. In this case the images have for their formulæ the following:—

O O	O E	E O	E E
$A + A'$	$A + A'$	$2A$	$2A'$

in other words, O O and E O will show similar tints, and E O, E E complementary. A similar result will ensue if $B = A$, $B' = A'$.

Again, even when neither of the foregoing conditions are fulfilled, we may still, owing to the breadth of the interference bands, have such an effect produced that sensibly to the eye

$$B + A = B' + A'$$

and in that case

$$\begin{aligned} B' + A &= B + A - A' + A \\ &= B + A' + 2A - 2A' \end{aligned}$$

which imply that the images O O and O E may have the same tint; but that E O and E E need not on that account be complementary. They will differ in tint in this, that E E, having lost the same tints as E O, will have lost also the tint A, and will have received besides the addition of two measures of the tint A′.

Effect of Combination of two Colours.—A similar train of reasoning might be applied to the triple overlaps. But the main interest of these parts of the figure consists in this, that each of the triple overlaps is complementary to the fourth single image; since the recombination of all four must reproduce white light. Hence the tint of each triple overlap is the same to the eye as the mixture of the two tints suppressed in the remaining image. And since by suitably turning the Nicol N or the prism P_1, or both, we can give any required position to the two bands of extinction, we have the means of exhibiting to the eye the results of the mixture of tints due to any two bands at pleasure.

Effect of Combinations of three Colours.—A further step may be made in the combination of colours by using a third quartz Q_2 and a third double-image prism P_2, which will give rise to eight images. And if C C′ be the complementaries extinguished by the combination $Q_2 P_2$, the formulæ for the eight images may be thus written:—

O O O	$C + B + A$
O O E	$C + B' + A'$
O E O	$C' + B' + A$
O E E	$C' + B + A'$
E O O	$C' + B + A$
E O E	$C' + B' + A'$
E E O	$C + B' + A$
E E E	$C + B + A'$

The total number of combinations of tint given by the compartments of the complete figure will be

$\frac{8}{1}$	= 8 single images		
$\frac{8 \cdot 7}{1 \cdot 2}$	= 28 overlaps of two		
$\frac{8 \cdot 7 \cdot 6}{1 \cdot 2 \cdot 3}$	= 56	„	three
$\frac{8 \cdot 7 \cdot 6 \cdot 5}{1 \cdot 2 \cdot 3 \cdot 4}$	= 70	„	four
$\frac{8 \cdot 7 \cdot 6}{1 \cdot 2 \cdot 3}$	= 56	„	five
$\frac{8 \cdot 7}{1 \cdot 2}$	= 28	„	six
$\frac{8}{1}$	= 8	„	seven
1	= 1	„	eight
Total . .	255		

The most interesting features of the figure consists in this, that the subjoined pairs are complementary to one another, viz.:—

O O O $C + B + A$	E O E $C' + B' + A'$
E O O $C' + B + A$	O O E $C + B' + A'$
E E O $C + B' + A$	O E E $C' + B + A'$
E E E $C + B + A'$	O E O $C' + B' + A$

And if the prisms P, P_1, P_2 are so arranged that the separations due to them respectively are directed parallel to the sides of an equilateral triangle, the images will be disposed thus:—

$$\begin{array}{cccc} & \mathrm{OEO} & \mathrm{OOO} & \\ \mathrm{EEO} & \mathrm{EOO} & \mathrm{OEE} & \mathrm{OOE} \\ & \mathrm{EEE} & \mathrm{EOE} & \end{array}$$

The complementary pairs can then be read off, two horizontally and two vertically, by taking alternate pairs, one in each of the two vertical, and two in the one horizontal row. And each image will then represent the mixture of the three tints suppressed in the complementary image.

Low-tint Colours.—A slight modification of the arrangement above described furnishes an illustration of the conclusions stated by Helmholtz, viz. that the low-tint colours (couleurs degradées), such as russet, brown, olive-green, peacock-blue, &c., are the result of relatively low illumination. He mentioned that he obtained these effects by diminishing the intensity of the light in the colours to be examined, and by at the same time maintaining a brilliantly illuminated patch in an adjoining part of the field of view. If therefore we use the combination N, Q, P, P_1 (*i.e.* if we remove the second quartz plate), we can, by turning the prism round, diminish to any required extent the intensity of the light in one pair of the complementary images, and at the same time increase that in the other pair. This is equivalent to the conditions of Helmholtz's experiments; and the tints in question will be found to be produced.

W. SPOTTISWOODE

VENUS'S FLY-TRAP (*Dionæa muscipula*) *

II.

Contractility of Dionæa.—I have given you a general view of our plant and of its behaviour. We next proceed to examine more particularly that property of contracting when irritated to which the plant owes its faculty of catching insects, and to which my own investigations have been directed. Before beginning the experimental demonstration of the facts, I wish to lay before you some considerations relating to the nature of this property as it manifests itself in living beings belonging to both kingdoms.

We have to do here not merely with contractility but with irrito-contractility. The fact that the property requires two words to express it implies that there are two things to express, viz. (1) that contraction takes place, and (2) that it takes place in answer to irritation. As this is the case not only here, but in all other instances of animal or vegetable active motion, we recognise in physiology these two properties as fundamental: irritability, or *excitability*, and *contractility*, the former designating the property possessed by every living structure whatsoever of being excited to action (*i.e.* of having its stored-up force discharged) by some motion or disturbance from outside; the latter, that kind of discharge or action which results in change of form, and usually declares itself in the doing of mechanical work. This property of excitability, which, let me repeat, is common to all living structures, is, as we have seen, comparable in its simplest manifestations to that possessed by many chemical compounds (of explosiveness) and many mechanical contrivances (of going off or discharging when meddled with, as in the case of the rat-trap already referred to).

In physiology, as in the other sciences of observation, the process of investigation is, throughout, one of comparison. Not only do we proceed from first to last from the known towards the unknown, but what we speak of as our knowledge or understanding of any new fact consists simply in our being able to bring it into relation with other facts previously well ascertained and familiar, just as the geographer determines the position of a new locality by ascertaining its topographical relation to others already on the chart.

The comparison we have to make this evening is between the contractility displayed by the leaf of Dionæa and the contractility of muscle. I choose muscle as the standard of comparison, not merely because it is best known and has been investigated by the best physicists of our time, but because its properties are easily illustrated and understood. I shall be able to show that the resemblance between the contraction of muscle and that of the leaf is so wonderfully complete that the further we pursue the inquiry the more striking does it appear. Whether we bring the microscope to bear on the structural changes which accompany contraction, or employ the still more delicate instruments of research which you have before you this evening, in order to determine and measure the electrical changes which take place in connection with it, we find that the two processes correspond in every essential particular so closely, that we can have no doubt of their identity.

Muscle, like every other living tissue, is the seat, so long as it lives, of chemical changes, which, if the tissue is mature, consist entirely in the disintegration of chemical compounds and the dissipation of the force stored up in these compounds, in the form of heat or some other kind of motion. This happens when the muscle is at rest, but much more actively when it is contracting, in which condition it not only produces more heat than it produces at other times, but also may do—and, under ordinary circumstances, does—mechanical work; these effects of contraction of muscle are, of course, dependent in quantity on the chemical disintegration which goes on in its interior.

Again, muscle so long as it is in the living state is electromotive. This property it probably possesses in common with other living tissues, for it is very likely that every vital act is connected with electrical change in the living part. But in muscle, as well as other irritable and contractile tissues in animals, the manifestation of electromotive force is inseparably connected with the special function of the tissue, *i.e.* with contraction, the connection being of such a nature that the electromotive force expresses, not the work actually done at any given moment, but the capacity for work. Thus, so long as the muscle lives, its electromotive force is found to be on the whole proportional to its vigour. As it gradually loses its vitality, its power of contracting and its electromotive force disappear *pari passu*. When it contracts, the manifestation of electromotive force diminishes in proportion to the degree of contraction. But it is to be borne in mind that, although when the muscle or the leaf contracts electromotive force disappears and work is done, there is no reason for supposing that there is any conversion of the one effect into the other, or that the source of the force exercised by the organ in contracting is electrical.

The lecturer then proceeded to demonstrate the correspondence between the electrical phenomena which accompany muscular contraction, and those which are associated with the closing of the Dionæa leaf, by a series of experiments.*

1. The form of the gastrocnemius muscle of the frog, in the uncontracted state, was projected on the screen with the aid of the electric light. A contraction was then determined by passing through it a single opening induction shock. It was seen to shorten and to become proportionately broader.

[In contraction, the bulk of a muscle remains unaltered. Further, the change of shape of the whole muscle depends on an exactly similar change of shape of every particle of which it is composed. This might be inferred from the consideration that a muscle is not an apparatus made up of parts differing from each other in structure, but a mass of substance equally instinct with life in every part. We know it to be the case by direct observation, for if we observe living muscle in the act of contraction under the microscope (as can easily be done in the muscles of insects),† we see that each minutest fibre participates in the change of form. The same holds good as regards the plant. The agent in the contraction is, without doubt, the protoplasm of the cells of the contractile organs. In Dionæa this has not as yet been sufficiently investigated, but in Drosera Mr. Darwin has shown that when the hairs which project from the upper surface of the leaf, become "incurved" under the exciting influence of appropriate stimuli, the contents of the cells undergo a most peculiar change of form and arrangement, which Mr. Darwin has described as "aggregation."]

---

* Continued from p. 107.

* The statements contained in the first part of this lecture, especially those relating to the mechanism of the closure of the Dionæa leaf and its digestion, are founded almost entirely on information which I owe to Mr. Darwin The experiments which led to the discovery of the "leaf current" and its "negative variation" were made last autumn, Mr. Darwin having kindly furnished me with plants for the purpose —J. B. S.

† See Schafer "On the Contraction of the Muscles of the Water-beetle Phil Trans, vol. clxiii. p 429, 1873.

2. The image reflected by the mirror of a Thomson's galvanometer having been thrown on the screen near its right edge, it was first shown that when a fraction of a voltaic current passed through the electrodes in a direction from the lecturer's right hand towards his left, the spot on the screen moved towards the left of his audience. The galvanometer having been shut off, a muscle was placed on the electrodes with its cut surface against the left (*e'*) electrode, and its natural surface against the right (*e*). On again connecting the electrodes with the galvanometer the spot flew off in the same direction as before.

3. The nerve of the muscle having been placed across two wires in connection with the ends of the secondary coil of a Du Bois' induction apparatus, was excited by induced currents, the muscle remaining on the electrodes. The spot returned towards its original position.

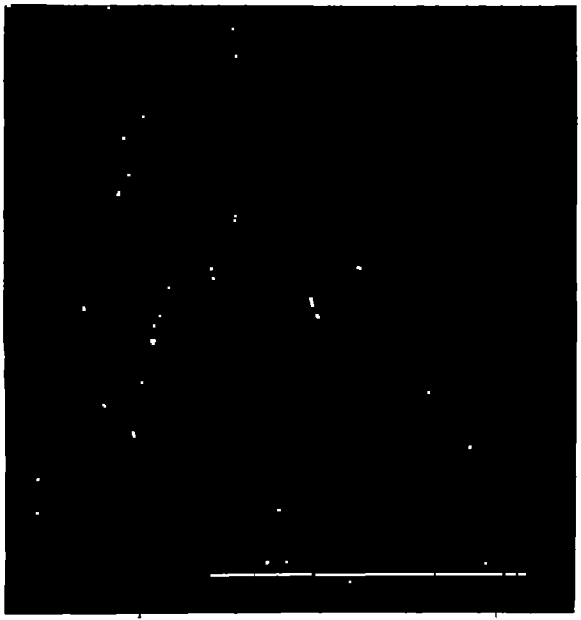


Fig. 1.—Diagram of the experiments.—S, screen facing the audience; E, position of electric light; G, reflecting galvanometer, *m* indicates the direction of the needle and of the mirror fixed to it; O, position of the bright image on the screen when no current exists in the galvanometer; L, end of the lecturer's table to his right; *e e'* his electrodes, on which the blade of the leaf *l* rests, with its stalk *s* towards the lecturer's right; *w w'*, wires leading to the galvanometer. The arrows show the direction in which the current flows through the galvanometer when the leaf is in the position shown. The arrow near O indicates the direction in which the spot of light moves under the influence of such a current.

[In both of these experiments only one-tenth of the muscle-current was allowed to pass through the galvanometer. The electrodes used, which are constructed on the same principle as those of Du Bois-Reymond, are shown in Fig. 2. The glass U-tubes A A' are half filled with saturated solution of sulphate of zinc. The zinc rods B B' are in metallic connection with the galvanometer ends by the wires W W'. The ends by which they dip into the solution are carefully amalgamated. The straight tubes C C' are of such width that they slip easily into the mouths of the U-tubes: they are prevented from going too far by rims of sealing-wax. These tubes are filled with a paste made by rubbing up modelling-clay with one per cent. solution of common salt. The electrodes are so supported that their distance and relative position can be varied with great facility.]

4. The heart of a frog was then placed with its apex against the left electrode (*e'*) and its base on the right (*e*). The spot moved in the same direction as before, but each heart-beat was marked by a sudden return of the needle towards its original position, indicating the instantaneous disappearance of electromotive force in the act of contraction. The effect corresponding to the contraction of the auricles could even be distinguished from that of the ventricular contraction which succeeded it.

5. A leaf of Dionæa, with its leaf-stalk still attached, was placed with its stalk end on the left electrode and its point on the right, as in Fig. 1. The direction of movement was the same.

6. The spot having assumed a fixed position on the screen, the leaf was excited by touching the sensitive hairs with a camel-hair pencil. The spot flew back towards the right edge of the screen, immediately afterwards returning to its original position. This effect was repeated several times.

7. The leaf-stalk was cut off, the leaf remaining as before on the electrodes. The deflection was increased (more than doubled). It was then explained that when the leaf-stalk is itself placed on the electrodes, the galvanometer indicates the existence of a current opposed in direction to that of the leaf, showing that the electrical conditions on opposite sides of the joint between stalk and leaf are antagonistic to each other. Consequently, so long as leaf and stalk are united, each prevents or diminishes the manifestation of electromotive force by the other. This is completely in accordance with what is observed with reference to nerve, and is known as "electrotonic variation of the nerve current."

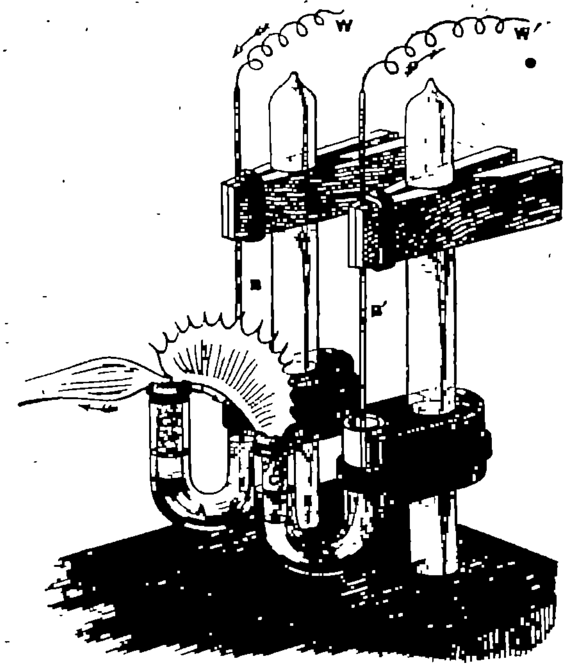


Fig. 2.—Non-polarisable electrodes employed in experiments on the Dionæa leaf.

8. Two fine-pointed electrodes, each in connection with one end of the secondary coil of the induction apparatus, were thrust into the centre of the external surface of a leaf, the ends of which rested on the electrodes of the galvanometer. On thus exciting the leaf the spot of light shot to the left, but it was observed that there was an obvious interval of time between the excitation and the effect. This period, though of much greater duration, corresponds to the so-called "period of latent stimulation" in muscle.

The plants exhibited and used for the experiments were provided by the kindness of the Director of the Royal Gardens, Kew.

FERTILISATION OF FLOWERS BY INSECTS[*]

VI.

Different Modes of Self-fertilisation where Visits of Insects are wanting

THE two functions of cross-fertilisation and self-fertilisation, which in the previous articles we have seen to occur in different forms of the same species or genus, are in most cases successively presented by the same form of flower; and the modifications by which self-fertilisation is attained by different plants, where visits of insects are wanting, are almost as various as the contrivances by which cross-fertilisation by insects is secured. Of these various modes I shall here speak only of some not yet referred to in my book on fertilisation.[†]

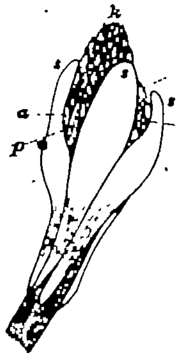


FIG. 32.

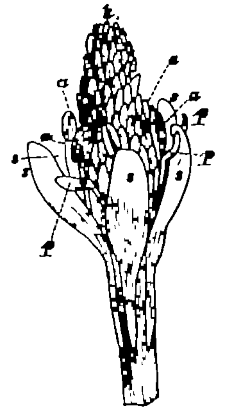


FIG 33

FIG. 32.—Side view of flower of *Myosurus minimus* before opening. FIG. 33.—Side view of a flower just open.

Myosurus minimus is as remarkable for the great variability in the size of its flower (compare Figs. 35 and 38) and in the number of its parts,[‡] as for the enormous growth of the cone of pistils, which affords no other benefit to the plant but the self-fertilisation of the greater part of the numerous stigmas by the small number of anthers, in case it is not visited by insects.

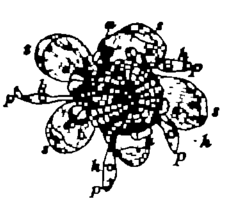


FIG 34.

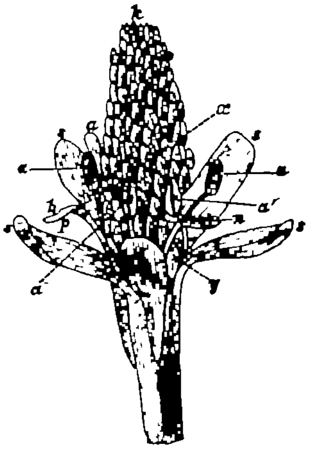


FIG. 35

FIG. 34.—The same flower viewed from above. FIG. 35—Side view of a somewhat older flower.

When the flower opens, it stretches forth its small petals (p), which serve as nectaries (n), and offer a small drop of honey (k), by which very minute insects are attracted in sunny weather. These visitors are for the most part Diptera not exceeding 1-1¼ mm. in length, belonging to the genera Sciara, Chironomus,[*] Hydrellia,[*] Scatopse,[†] Phora, Cecidomyia, Oscinis, and Microphorus. I observed also a single specimen of *Melanostoma mellina* (Syrphidæ), some Anthomyia (Muscidæ), a small Haltica, some Pteromalidæ, and small Ichneumonidæ. These minute visitors licking up the drops of honey, and walking round the cones of ovaries, stop many seconds in a single flower before visiting another. The anthers, lying close round the cone of ovaries, open by two lateral slits, and are soon afterwards covered with pollen on their whole outside; consequently, insects walking round the ovaries may easily be charged with pollen, and flying to another flower effect cross-fertilisation. But, upon the whole, the flowers, because of their being scentless and very inconspicuous, are so scantily visited by insects, that, after repeated careful examinations, I believe that even in sunny weather more than 90 per cent. of the flowers remain without any visit. This deficiency of secured cross-fertilisation is supplied by regular self-fertilisation in the following manner. The axis of the flower, extending gradually during the blooming-time into a long cone, brings a great part of the stigmas into contact with the lateral pollen-grains of the anthers; those ovaries which now are in contact with the anthers soon afterwards overgrowing them, and others now below the anthers reaching them.[‡] Thus a number of styles grazing the anthers during the growth of the long cone are self-fertilised by about five or more pollen-grains (Fig. 36); besides, also, the lowest stigmas of the flower are fertilised by their own pollen, many pollen-grains falling down from the anthers (Fig. 35 y, Fig. 37). Consequently, only those ovaries are never self-fertilised which

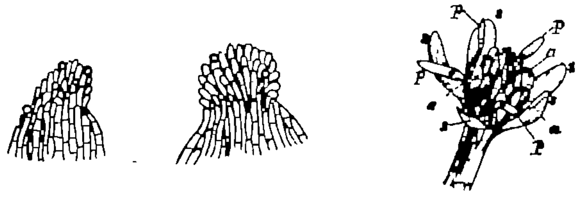


FIG 36. FIG. 37. FIG 38

FIG 36—Stigma of the ovary x, Fig. 35, provided with pollen-grains from the anther a', which have already emitted their pollen-tubes FIG 37—Stigma of the ovary y, Fig. 35, more developed than the stigma, Fig. 36, provided with two pollen-grains fallen down from the anther a' FIG. 38—One of the smallest flowers: s, sepal, p, petal, n, nectary, k, honey, k, cone of ovaries. FIGS. 32–35 and 38, seven times natural size.

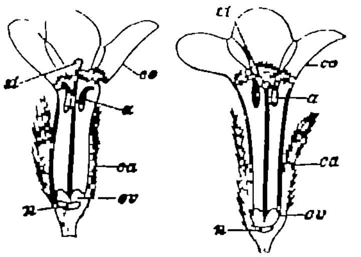


FIG. 39. FIG. 40.

FIG 39—Flower of *Myosotis versicolor* when just opened, dissected longitudinally FIG 40—An older flower, with full-grown corolla (seven times natural size): *ca* calyx, *co* corolla, *a* anthers, *st* stigma, *n* nectary, *ov* ovary.

---

[*] Continued from vol. ix. p. 166

[†] "Die Befruchtung der Blumen durch Insecten," Leipzig, 1873.

[‡] I examined a hundred flowers as to the number of sepals, petals, and anthers, and found the number of sepals in 3 flowers = 4, in 94 flowers = 5, in 3 flowers = 6, petals in 2 flowers = 2, in 60 flowers = 3, in 3 flowers = 4, in 35 flowers = 5; anthers in 2 flowers = 3, in 2 flowers = 4, in 11 flowers = 5, in 22 flowers = 6, in 31 flowers = 7, in 46 flowers = 8, in 5 flowers = 9, in 1 flower = 11.

[*] For instance, *Chironomus byssinus* Schrk., *Hydrellia chrysostoma* Meig., and *griseola* Fall., after Prof. Mik's (of Vienna) examination.

[†] *Scatopse brevicornis* Löw.

[‡] This is easy to be seen by marking some of the ovaries with a spot of ink.

are already situated above the anthers before the opening of the flower.

Whilst in *Myosurus minimus* self-fertilisation is effected by a number of stigmas passing along each of the anthers, *Myosotis versicolor* attains the same effect in the contrary way, all five anthers of the flower passing along the single stigma.

The corolla, when opening, is not only still of a pale yellowish colour, like the buds of other species of Myosotis, but even when not yet fully developed the anthers and pistils are mature at the same time and the stigma slightly overtops the corolla. Hence when insects visit the flowers in this state, their probosces always touch the stigma sooner than the anthers, and consequently, when flying to another flower, always cross-fertilise it.

But by the gradual lengthening of the corolla-tube the anthers affixed to its inner side are raised till they surround and self-fertilise the stigma now enclosed in the corolla (Fig. 40). Thus also in this inconspicuous flower the defective cross-fertilisation by insects * is largely supplied by regular self-fertilisation.

HERMANN MULLER

INTERNATIONAL METRIC COMMISSION AT PARIS

Melting of the Metal for the new Metric Standards

AT the meeting of the Executive Committee of the International Metric Commission in October last, the fusion of the large single ingot of platinum-iridium, weighing 250 kilogrammes, out of which all the new metric standards were to be constructed, was fixed for the end of the following April, but the completion of the operation was delayed by accidental circumstances until the middle of the following month. As this was the first occasion on which any attempt had ever been made to melt together more than a few kilogrammes of platinum or of platinum alloyed with iridium, it was necessary to make a great number of experimental meltings during the intermediate time in order to secure success in the great operation.

All the actual meltings of the platinum and iridium have been made at the Conservatoire des Arts et Métiers, in a building erected for the purpose. The work has been carried out under the superintendence of M. Tresca, the Sous-Directeur of the Conservatoire, who is also honorary secretary of the Commission, and more immediately intrusted with the technical operations of constructing the new standards. He has had the advantage of the cordial assistance of Mr. George Matthey, of the firm of Johnson and Matthey, Hatton Garden, from whom the large mass of platinum and iridium was obtained. Mr. G. Matthey has had large personal experience in melting platinum, and he remained at Paris from the beginning of April assisting in the work.

It was necessary that the whole of the platinum and iridium should be separately assayed and purified previously to their being melted together. This process was entrusted to M. Henri Sainte-Claire Deville, and carried out at the Ecole Normale, of which he is director. The greatest difficulty in the purification consisted in getting rid of the osmium, which is found in the natural ore in combination with platinum and with iridium. But the chemical difficulty was satisfactorily overcome by M. Deville after many experiments made by him.

The whole of the platinum and iridium had thus been ascertained to be perfectly pure when delivered to M. Tresca for melting. The first process was to melt portions of the pure platinum, its melting point being about 1,900° C., and considerably lower than that of iridium, which is about 2,400° C. Portions of the platinum were then remelted together with iridium, in the proportions fixed upon of 90 per cent. of platinum and 10 per cent. of iridium. Quantities of from 10 to 15 kilogrammes of platinum-iridium were, in the first instance, melted together. Several of these smaller ingots were then remelted into larger ingots of rather more than 80 kilogrammes each, and the final operation was to remelt three of these larger ingots into a single ingot of 250 kilogrammes.

Each of the meltings was made as nearly as possible of uniform form in a furnace heated with oxy-hydrogen gas. The furnace was made of a block of the ordinary sandy limestone used for buildings in Paris. For the smaller ingots a square block of stone was employed with a hemispherical cavity about 6 in. (15 centimetres) in diameter, for containing the metal. This small block had a cover of similar form, and through its middle was a vertical hole, about ¾ in. in diameter, in which the tube for conveying the gas was fixed with mortar. When the metal was placed in the furnace, and the jet of lighted gas directed upon it, sufficient mortar was placed on the joining of the upper and lower blocks of stone to make it air-tight. For the three larger ingots a long oblong furnace was used, with a cavity of the same breadth, but a little deeper and much longer, and three gas-tubes were used. The largest furnace required for the whole quantity of metal had six gas-tubes, each about 1 in. in diameter, inserted in the upper block. The ordinary illuminating gas was used, mixed with the requisite proportion of oxygen gas, made on the premises and stored in a large gasometer placed near the furnace-room. For obtaining a sufficient blast the power of a 15-horse steam-engine was employed.

In order to facilitate the melting, it was necessary first to divide the larger ingots into small pieces. About half the quantity for a single melting, thus divided into small lumps, was placed in the mould, and when this was completely melted the remainder, which had been drawn out into long thin bars, was introduced gradually through two small holes opposite each other in the furnace. These holes also enabled the interior of the furnace to be seen, together with the progress of the melting, and they could be closed by stone plugs when requisite. The division of the ingots was a difficult operation, as this alloy of platinum and iridium is harder than ordinary steel. A V cut, about ⅛ in. deep, was made around the ingot with a cold chisel, though not without splintering the edges of a considerable number of the best-tempered chisels. The ingot was then placed under a hydraulic press, supported upon the rounded tops of two strong iron bars, a sufficient distance apart. The rounded part of a third bar was placed upon the ingot, in the line of the cut, and the power of the press being applied, the ingot was broken in half, presenting in every instance a regular crystallised grain.

The melted metal was not cast into a separate mould, but was allowed to cool in the furnace. During the melting a portion of the interior of the stone, to the depth of about half an inch, became coloured by the excessive heat and formed into lime in a powdery state, which floated on the surface of the melted metal. When the metal was sufficiently cool, the stone mould was broken and the ingot removed to a bath of hydrochloric acid, which dissolved every portion of lime or other foreign matter upon the surface of the ingot, but does not act upon platinum-iridium. The ingot was then left quite clean and pure.

The first of the larger ingots of 80 kilogrammes was successfully melted on April 25. The second was melted on May 1, when Marshal MacMahon, the President of the

---

* After having repeatedly watched in vain the flowers of *Myosotis versicolor*, I succeeded twice in seeing it fertilised by insects, viz.—May 15, 1873, I observed *Bombus agrorum* F. ♀, and June 2, 1873, *Halictus sexnotatus* K. ♀, *H. sexnotulus* Sm. ♀, *Rhingia rostrata* L., and *Syritta pipiens* L., all of them successively sucking flowers of different stems. But certainly by far the greatest part of all the flower remains without any visit of insects.

Republic, accompanied by M. Deseilligny, the Minister of Commerce, were present unofficially, and remained during the whole process, appearing to take great interest in the operations. The third of the larger ingots was melted on May 7.

The melting of the great ingot of 250 kilogrammes took place on May 13, in presence of nearly every member of the French Section of the Commission, of M. Struve from St. Petersburg, MM. Stas and Heusschen from Brussels, M. Bosscha from Holland, Prof. Miller and Mr. Chisholm, delegates from Great Britain, and other foreign commissioners. It was successfully accomplished with the greatest facility and regularity, and without the slightest hitch or accident.

The dimensions of the cavity in the furnace, and consequently of the large ingots produced, were as follows :—

	Mètre		Inch
Length	1·24,	or about	44·9
Breadth	0·15,	„	5·9
Depth	0·07,	„	2·8
Thickness of stone above the cavity	0·15	„	5·9

The time occupied in the process was as follows :—

2.10 P.M.—Furnace heated and lighted by degrees.
2.24 „ —Furnace thoroughly heated.
3.4 „ —Contents of metal (130 kilogrammes) melted and bars begun to be introduced.
3.27 „ —All the metal melted.
4.15 „ —Metal entirely solid, but still at white heat; lid lifted.

In about half an hour the mould was broken and the ingot removed to the hydrochloric bath. When taken out it was examined, and found, to all appearance, perfect.

The stone used is so remarkably slow a conductor of heat, that when the whole mass of metal was in a melted state the upper surface of the stone was hardly warm, as was tested by the hands of several of the persons present being placed upon it.

Portions of the three large ingots had been previously tested and found to be very nearly indeed of pure platinum and pure iridium in the proportions of 9 to 1. The large ingot will also be assayed, and, if deemed necessary, again melted, in order that the requisite homogeneity may be attained.

The work of constructing all the new line-standard metres from this single ingot will at once be proceeded with, and there will be sufficient surplus metal for making first all the new standard kilogrammes, and then such number of end-standard metres as may be required.

H. W. CHISHOLM

SOUNDINGS IN THE PACIFIC

THE voyages of the U.S. steamer *Tuscarora*, Capt. Belknap, engaged in soundings for a cable from America to Japan, have been already described between Cape Flattery and Oonalaska Island (vol. ix. p. 150), and between California and the Sandwich Islands. They have now been extended from the last-named station to the coast of Japan. Sixty casts were taken at intervals of about 50 miles. In the first 95 miles from Honolulu, the depth increased at nearly 162 ft. to a mile, reaching 2,418 fathoms in lat. 21° N., long. 159° 20′ W. The average depth of all the casts taken during this voyage was 2,450 fathoms. Between the mountains (all but one of which are entirely submarine) the bed of the ocean was very level; the greatest depth was found at lat. 22° 44′ N., long. 168° 23′ E., 3,262 fathoms. These mountains were as follows :—(1) Summit about lat. 20° 41′ N., long. 171° 33′ W.; height 5,160 ft.; eastern slope 40 ft. and western 128 ft. to the mile. (2) Summit, lat. 21° 41′ N., long. 176° 54′ E.; height 12,000 ft.; eastern slope 37 ft. for about 127 miles and 51 ft. thence to summit; western slope 55 ft. (3) Summit 23° 45′ N., long. 160° 56′ E.; height 9,600 ft.; eastern slope 192 ft.; western 204 ft. (4) Summit, lat. 23° 55′ N., long. 158° 7′ E.; height 6,000 ft.; eastern slope 60 ft.; western, inappreciable for 45 miles from summit, afterwards 90 ft. per mile to its base. (5) Summit above water, known as Marcus Island, lat. 24° 12′ N., long. 153° 57′ E. Soundings 7 miles to northward, lat. 24° 20′ N., long. 154° 6′ E., gave 1,500 fathoms depth; northern slope to this point 1,284 ft. to the mile; eastern slope thence, 200 ft.; western 157 ft. (6) Summit, lat. 25° 42′ N., long. 148° 39′ E.; height 7,800 ft.; eastern slope 163 ft.; western 59 ft. From the base of the last mountain to Port Lloyd, Peele Island, the upward slope was 86 ft. to the mile. All the slopes are estimated at a minimum.

All specimens brought up from summits of mountains or ridges were white coral or pieces of lava, and indicated otherwise a hard and rocky bottom: all from the level bed were of soft brownish-yellow mud. It will be noticed that the position of Marcus Island has been hitherto incorrectly indicated on the charts—too much to the north and west. It is about 4 miles in length from east to west and is thickly wooded and frequented by large flocks of birds. Another island laid down on the charts as somewhat to the southward of Marcus Island has no existence, and the facts are similar in regard to several reported shoals and rocks indicated on the charts; the *Tuscarora* sailed over their alleged positions, and found from 1,500 to 3,000 fathoms of water.

Bottom temperatures, as in other parts of the Pacific, range from 33°·2 F. to 34°·6 below 1,800 fathoms, whatever the additional depth. Between 1,200 and 1,800 fathoms the temperature rises slowly to about 35° at the former depth. From 1,200 fathoms to the surface the thermometer rose steadily; surface temperatures ranging from 70° to 76° F.

Observations on currents are made from a boat when the sea is moderately smooth. For investigating deep currents the sinker of the apparatus is of about 10 lbs. weight; it consists of four rectangular pieces of doubled tin soldered at right angles to each other, each 6 in. square, and with the requisite quantity of lead attached in strips through holes punched in the lower edges of the sheets. A small silk fishing-line supports the sinker, running through the float, which is a wooden cube 5 in. square at the surface by 4 in. in depth; the line runs to a reel in the boat, having a toggle placed on it just above the float. For observing surface currents a similar sinker is constructed of wood weighted to sink about 2 fathoms. The line attached to it is marked in tenths of knots by small corks, which also prevent errors that would otherwise accrue by the line sinking.

A fixed point of departure is obtained by lowering the sounding apparatus and bringing the sounding wire in a vertical position after bottom is reached. From this point the current-measuring apparatus is thrown overboard, and its rate and direction of progress measured at frequent intervals of time. The small errors due to friction are easily eliminated, and the elements of calculation are exceedingly simple. An approximate method of obtaining the surface current when dredging is by anchoring the boat to the dredge lines as a fixed point. In deep currents the float is vertical over the sinker.

The voyage occupied twenty-eight days, and the weather was exceptionally favourable. There are only sixty-five inhabitants on Peele Island, and the *Tuscarora* was the first visit of a naval vessel for more than seventeen years; Commodore Perry stopped at the island in 1853. A Mr. Savory, formerly a whaler, from Massachusetts, had exercised the functions of governor, consisting principally of presiding over marriages and funerals, for many years, and died last March at the age of eighty, a Mr. Thomas Webb succeeding to the position and honours. In 1827 Capt. Beechy, R.N., took possession of the island in the name of George II., but the Japanese claim it by right of prior discovery and occupation. It is principally frequented by whalers, for supplies. There are no notable features in the sea-bed between this island and the coast of Japan.

COGGIA'S COMET

THE latest observations taken here give the following position of this comet, which, compared with that of June, published in NATURE, vol. x. p. 113, shows the present direction of the motion.

June 14, at 10h. 42m. 30s. mean time at Twickenham.

R.A.	7h. 7m. 24·56s.
D.	+ 68° 56′ 31″·5

The comet on this evening was distinctly visible to the naked eye, sensibly brighter than 43 Camelopardi, and therefore rather higher than the fifth magnitude. Towards midnight it was possible to detect a difference between its appearance, without the telescope, and that of neighbouring stars.

There appears a decided similarity between the elements of this comet and those of the second comet of 1737 observed by the French Missionaries in China. For the latter body I have calculated the following orbit, from the observations, or rather the estimated places, published by the Baron de Zach (Mon. Corresp. xxi. p. 318).

Perihelion passage 1737, June 2·230 Greenwich M.T.

	° ′
Longitude of perihelion	261 58
Ascending node	132 5
Inclination of orbit	61 52
Perihelion distance	0·8348

Motion—Direct.

Daussy's elements of this comet which appear in our catalogues are certainly defective.

The present comet was detected when the true anomaly before perihelion exceeded 100°, and there is every probability that Mr. Stone at the Cape of Good Hope may be able to furnish a good normal place at a large arc of anomaly after perihelion. Hence the period of the comet may be determined directly from the observations. In another week's time we shall doubtless know very nearly the course which it will take when near the earth and sun in the first half of July; but so far, the determination of the elements has been one of no ordinary difficulty, as I find the continental computers have remarked as well as myself.

J. R. HIND

Mr. Bishop's Observatory, Twickenham,
June 16

NOTES

WE need not say much on Monday night's debate as to the appointment of a minister of Education; as we have already often referred to the subject our ideas must be known. Mr. Lyon Playfair's appeal was certainly strong, unanswerable we think, but it referred too much to education and too little to science. Our scientific administration ought to be as strong as that of our law, and we are confident that it ultimately will be. Sir John Lubbock's speech was admirable. He said it was surely a great mistake to suppose that the business of an Education Minister would be confined to questions relating to elementary schools. We must, he thought, take a broader view of the question. "We had," he said, "large educational endowments, but a system which was not even now in harmony with the present state of things, and which consequently does not produce the results which might reasonably be expected. If there had been a Minister of Education the Endowed Schools would not have been allowed to fall into the condition in which too many of them were when the Endowed Schools Act was passed." Speaking of the Fellowships of Oxford and Cambridge, numbering 720, he said, "Out of the whole number he believed that not above a dozen had been given for proficiency in Natural Science, while even as regarded the Scholarships those offered for Natural Science are only a small fraction of the whole. But then the Colleges said, and said with some force, that they could not do more for Natural Science because the subject was not sufficiently taught in the schools; while, on the other hand, the schools did not teach it because so few inducements were held out at the Universities. Both admitted that a change was needed, but each was waiting for the other. Here, again, the influence of some co-ordinating authority was much needed. Then there was the management of our museums. It was generally felt that the erection of the new Natural History Museum at South Kensington should be taken advantage of to effect a change in the governing authority of the British Museum; that, as recommended by the Science Commission, the national collections should be under the charge of directors, responsible to a special Minister of State. At present the different national collections were in competition, not in harmony." The arguments urged in favour of the appointment of an Education Minister were simply eluded by its opponents, though it is at least consoling to think that Mr. Disraeli's speech was carefully guarded; indeed the opinion of many is that in time he will see his way to supporting the appointment of such a Minister.

IN reply to a question in the House of Commons on Monday Lord Sandon stated that arrangements had been made for bringing the various departments at the South Kensington Museum more directly under the control of the Education Department at Whitehall.

LORD RAYLEIGH, F.R.S., a member of the Council of the Mathematical Society, is about to do a very handsome thing, which will make that Society greatly indebted to him, and which should earn the gratitude of all mathematicians and therefore of all scientific workers. He has expressed his intention of presenting 1,000*l.* to the Mathematical Society to assist it in the publication of its Proceedings and in the purchase of mathematical periodicals. The application of this handsome gift shows great discrimination on the part of the donor.

THE Professorship of Zoology and Comparative Anatomy at King's College, London, is rendered vacant by the resignation of Mr. T. Rymer Jones, F.R.S., who has held it since the year 1836.

WE regret having to record the death on June 6 of Dr. Hermann Vogelsang, Professor in the Polytechnicum of Delft, at the early age of 36. He was well known for his various publications on subjects connected with the microscopical structure of rocks and minerals.

AT the meeting of the French Academy on June 8, the death was announced of M. Roulin, librarian to the Academy, and editor of the first volumes of the *Comptes Rendus.*

THE deputation of the Royal Geographical Society which waited on Government in reference to the family of the late Dr. Livingstone recommended that 10,000*l.* or 11,000*l.* should be granted; but it seems the Government have thought 3,000*l.* sufficient, with about 1,000*l.* by way of payment of arrears due to the followers and servants of the doctor. This is in addition to the 200*l.* pension, which is to be continued to the family. The Geographical Society seems to be quite satisfied with this arrangement.

IT seems to be generally allowed that this year's Cambridge commencement has been unusually brilliant; the number of honorary degrees conferred on Tuesday was very large. The names of the scientific men to whom the degree of LL.D. was given we have already mentioned. At the same time the thanks of the

University were conveyed to the Chancellor, the Duke of Devonshire, for his handsome gift of the Cavendish Laboratory. At the Oxford Encænia yesterday, the degree of D.C.L. was conferred, among others, upon Victor Carus, Professor of Comparative Anatomy and Zoology in the University of Leipzig.

We congratulate the University of Cambridge that its Board of Natural Science Studies have at last come to see that the Oxford system in the Natural Sciences Tripos is the only workable one, and the only one which can lead to really valuable results and the discouragement of cramming and superficiality. The Board having had under consideration the reports of the examiners for the Natural Sciences Tripos for several successive years, which express more or less dissatisfaction with the present system on account of the inducements it offers to the candidates to spread their reading over a wide area rather than to study deeply a limited section of natural sciences, think that the objects of the examination—viz. to offer sufficient stimulus to exertion, and at the same time to give encouragement to sound study—will be best secured by dividing the first class into two divisions, and by arranging the names in each of these divisions and in each of the other two classes in alphabetical order. They think it desirable that the first class should consist of those who, having shown adequate general knowledge in the first three days of the examination, have shown superior proficiency in some one, at least, of the branches of natural science included in the examination, and that in the case of every student placed in the first class, the subject or subjects for knowledge whereof he is placed in the first class be signified in the published list. They are also of opinion that it is desirable that those who pass the first three days' examination with credit should be entitled to admission to the B.A. degree. To carry out these recommendations the Board propose certain alterations in the rules of the Tripos defining more strictly the parts to be included in the first three days' examination, and add regulations to carry out their new scheme.

As the statute for settling the future stipend of the Professor of Geology at Oxford has now passed Convocation the Vice-Chancellor will proceed to an election in the course of the present month. Any gentlemen who have not already sent in their names are requested to do so on or before Saturday, June 20.

There are several points in connection with the Annual Commemoration of the University of Sydney, held on March 28 last, which are worthy of notice, and which must be pleasing to the friends of scientific education. The number of students attending lectures at the University during the past Session was 48, being the largest number at one time since the establishment of the University. The number of "superior graduates" now in the University is 87; on this reaching 100 it will be entitled to send a representative to the Legislative Assembly. In recognition of the zeal and efficiency with which Mr. Liversidge has performed his duties as Reader in Geology and Mineralogy, the Senate have promoted him to the higher grade and position of Professor in those sciences, and Demonstrator in Practical Chemistry, and have also voted 500*l.* for the improvement of his laboratories.

Further the Senate of Sydney University have made what many of our readers will regard as a wise law; viz. that candidates, who at the second yearly examination should have displayed a marked proficiency in any one of the three schools of classics, mathematics, or natural science, should be allowed, on the recommendation of the examiners, to devote themselves in their third year exclusively to the subjects of that school, and to be examined for B.A. in them only.

At the same commemoration, a very gratifying act of munificence was announced. Mr. William Macleay, M.L.A., F.L.S., has expressed his intention of bequeathing to the University his valuable library and collection of natural history, upon trust for the promotion of that science, and the instruction of the students and the inhabitants of the colony in the same. He also expresses his intention of leaving to the University the sum of 6,000*l.*, the interest upon which is to be applied to the payment of the salary of a properly-qualified curator, to be specially and exclusively employed in the care and preservation of the specimens belonging to the collection, or any additions that may be made to it. The library already consists of about 2,000 volumes, and Mr. Macleay states that he is continually adding to it all the most valuable of the periodicals and proceedings of Societies of Natural History, published in England, France, Germany, Belgium, and Russia. It includes a large number of books on Natural History, which belonged to the late Mr. William Sharpe Macleay, F.L.S., and which have been presented by his brother, Mr. George Macleay, C.M.G., F.L.S., to accompany the collection. The collection of specimens, we believe, may be considered one of the most extensive and valuable in the world. It was first formed by the late Alexander Macleay, F.R.S., F.L.S., and was considered about fifty years ago the first collection in Europe. Many additions were made to it by his son, the late Mr. W. S. Macleay, who, as well as his father, was considered one of the most eminent entomologists of his day. During the last fifteen years the collection has been greatly enriched by the present owner, Mr. William Macleay, by the accumulation of large numbers of Australian insects, besides a considerable collection from other parts of the world. The library and collection are to be maintained and known by the name of the "Macleayan Natural History Collection," and to be open to the inspection of the students of the University and the general public, at all such proper and convenient times as may be appointed for that purpose. From the admirable spirit which seems to animate the University of Sydney, we should think this munificent gift is likely to be fruitful of the best results.

On June 10 W. H. Miller, F.R.S., Professor of Mineralogy in the University of Cambridge, was elected a Fellow of St. John's College, Cambridge. Prof. Miller took his degree at the college and was formerly for several years a Fellow. He has now been elected for the second time under the statute empowering the college to elect as Fellow "any person eminent for Science or learning." At the same time the Very Rev. C. Merivale, Dean of Ely, Prof. J. C. Adams, and T. Todhunter were elected Honorary Fellows. C. T. Clough, and J. N. Langley have been elected Scholars for proficiency in Natural Science, and A. M. Marshall (Scholar 1873) has received an exhibition in augmentation of his scholarship. First class in the college examination in Natural Science (alphabetical order).—Clough, Langley, Marshall, and Stewart.

We are glad to see from the Fourth Annual Report of the Devon and Exeter Albert Memorial Museum, Schools of Science and Art, and Free Library, that all departments of the institution are in a flourishing and satisfactory condition. It is gratifying to see that the Science schools are gaining ground, and we hope the Committee will do all in its power to develop these and induce those for whose benefit they are intended to take advantage of them. The museum has been greatly improved during the past year by the addition of cases, the arrangement of specimens, and the acquisition of a number of skeletons of typical vertebrates.

We are pleased to see from the Sixteenth Report of the East Kent Natural History Society that it is in a satisfactory condition as regards members, funds, and work; the number of members at the end of 1873 was 97; several valuable and appropriate books have been added to the library and a new microscope purchased. Several important papers have been read bearing on local and general natural history.

The Committee of the Leeds Mechanics' Institute and Schools of Art and Science have resolved to accede to a generally expressed wish that they should organise a Yorkshire Exhibition of Arts and Manufactures, to be opened in Leeds on May 1, 1875. The object of the Exhibition will be to promote the Fine Arts and Art and Science as applied to Manufactures, and the surplus funds will be applied to the liquidation of the debt now remaining on the Leeds Mechanics' Institute.

A very successful meeting, under the presidency of the Mayor of Bristol, was held at the Victoria Rooms, Clifton, for the purpose of inaugurating the formation of a College of Science and Literature for the south and west of England and South Wales, to which we referred in Nature, vol. x. p. 93. The meeting was perfectly harmonious, and we have no doubt that the scheme so auspiciously begun will be successfully accomplished. It is evidently intended that science will hold an equally important place with literature in the new college.

Winge and Heiberg, of Christiania ("Die puerperalen und pyaemischen processe," H. Heiberg, Leipzig, 1873), point out the remarkable presence of a fungus, which is at least very like a vibrio, in the basis of the sore in cases of pyæmic ulcerative endocarditis (*Mycosis endocardii* Winge), and Heiberg shows in similar cases the crowding of such beings in the superficial lymphatics of some of the viscera. This appears to be an important contribution to the views of Lister as to the septic character of the pyæmic diseases.

A piece of native gold weighing 200 kilogrammes, and worth 24,000*l.*, has been found in French Guyana, and sent to Paris to be placed in the Colonial Exhibition at the Champs Elysées.

The French Academy of Sciences has held a long secret committee meeting on the propriety of granting to M. Chapelas-Coulvier-Gravier a sum of money for his meteoric observatory on the upper part of the Luxembourg Palace. A very strong opposition was offered, and it is doubtful whether the grant will be allowed.

Upwards of a year ago there was founded at Berlin in connection with the German Geographical Society, a "German Society for the Exploration of Equatorial Africa," or, shortly, the "African Society," having for its president the well-known Dr. Bastian, and vice-president Dr. Neumayer. The Society has received handsome subscriptions to enable it to carry out its object, including a large sum from the Government. An expedition under Dr. Paul Güssfeldt was soon organised, and in the end of May left Liverpool for the west coast of Africa, in the steamer *Nigritia*, which unfortunately was wrecked off Sierra Leone on June 14, Dr. Gussfeldt losing nearly all the equipments of the expedition. He got another ship to take him to Cabinda in Congo, the seat of the German African Trading Company, where he found Dr. Bastian, who had also gone out to organise the work of the expedition. From Cabinda as a starting-point, several journeys have already been made into the interior, and in the *Correspondenzblatt* of the Society, several numbers of which have been issued, an account of the work done is given in a number of letters from Dr. Bastian, Dr. Gussfeldt, and others.

We are glad to see that the governors of the Burnley Grammar School in the reconstruction of the buildings have given considerable facilities for the practical teaching of Science. They have provided, among other rooms, two well-contrived laboratories, one of which is to be devoted to chemical manipulation, and the other to experimental physics. The school is expected to open on August 1, and the governors have elected as headmaster Mr. Joseph Hough, B.A. (Cambridge), now Science Master at the Rossall School. It is likewise the intention of the governors to found a central science school, which shall be open in the evening for the instruction of persons occupied in the daytime in commercial pursuits. This school is intended to carry out the recommendation of the Commission on Scientific Instruction in one of their recent reports.

Mr. George Smith has returned from his second Assyrian expedition. He brings home a very large collection of new cuneiform tablets and fragments, as well as a great many interesting objects of Assyrian art, including the entire lintel in sculptured stone of one of the ancient palace gateways.

The forthcoming number of Petermann's *Geographische Mittheilungen* will contain an important contribution by Prof. Hanns Hofer, the geologist of Count Wilczek's expedition of 1872, on the geography of Spitzbergen. The paper contains the results of careful observation on the harbours, the configuration of the island, especially in the neighbourhood of Horn Sound, and on the glaciers, which were minutely explored.

A novelty in legislation consists in the recent introduction into the U.S. Congress of a bill proposing to grant the State of Minnesota 200,000 acres of land within its limits, the proceeds of which shall be kept as a perpetual fund, the interest to be applied to the support, maintenance, and equipment of an astronomical observatory and school of mines at St. Anthony's Falls in connection with the Minnesota State University. A special stipulation in this proposed act is that the schools shall be free of charge to all students.

We have received the first two numbers of the *Quarterly Journal of Conchology*, conducted by Messrs. W. Nelson and J. W. Taylor (Hardwicke). We should think it likely to prove of considerable value to the class to which it is addressed.

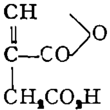
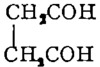
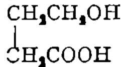
We have received the Report of the Ashmolean Society for the year 1873. During last year the Society has held Seven General Meetings, at which a number of valuable scientific papers were read by well-known men of science.

Messrs. Maclachlan and Stewart, of Edinburgh, have ready for immediate publication a work entitled the "Birds of Shetland," with observations on their habits, migration, and occasional occurrence, by the late Dr. Saxby. It will be published at one guinea.

The various learned bodies of Massachusetts, especially the American Academy of Arts and Sciences, and the Boston Society of Natural History, are urging upon the Legislature the importance of undertaking a new and thorough scientific survey of the commonwealth. The results expected from such a survey at the present time are a detailed topographical map on a scale of an inch to the mile, maps coloured to show the distribution of rock-formations and economic minerals, with charts on a larger scale of particular localities having special interest or importance; also full descriptions of everything connected with the theoretical and economical mineralogy and geology of the State, and especially full descriptions and truthful illustrations of the animals and plants, including their natural history, transformations, and relations to man and his requirements.

The additions to the Zoological Society's Gardens during the past week include a Vulturine Guinea Fowl (*Numida vulturina*) from East Africa, presented by Dr. J. Kirk; a Stump-tailed Lizard (*Trachydosaurus rugosus*) from Australia, presented by Mr. N. Clements; a Spotted Cavy (*Cælogenys paca*) from South America, presented by Mr. J. W. Alexander; a Crested Agouti (*Dasyprocta cristata*) from Colon, presented by Mrs. Wood; a Persian Gazelle (*Gazella subgutturosa*) and a Fennec Fox (*Canis fennec*) from Persia, presented by Mr. E. S. Dawes; two Cormorants (*Phalacrocorax carbo*), British, presented by Capt. Salvin; five Mandarin Ducks (*Aix galericulata*) hatched in the Gardens.

SCIENTIFIC SERIALS

Justus Liebig's Annalen der Chemie und Pharmacie. Band 171, Heft 2 und 3.—These parts contain the following papers:—On aldehyde derivatives of napthylamine, by Dr. G. Papasogli. Napthylamine sulphite gives with benzaldehyde napthylamine-benzoyl bisulphite, $C_{10}H_9N.SH_2O_3.C_7H_6O$. This substance is decomposed on heating into sulphur dioxide, water, and a resinous substance of the formula $C_{17}H_{13}N$.—Action of amides on phenol, by Dr. J. Guareschi. The author has tried the action of benzamide and acetamide, also the action of benzamide on cresol, on methyl salicylate, and on ethyl salicylate.—The same author contributes a paper on the various cymenes. Seventeen of these bodies are described and tabulated with bibliographical references. Franz Meilly contributes a long paper on aconitic acid, to which substance the author assigns the constitutional formula  .—The following are communications from the laboratory of applied chemistry at Hilger's University:—On Bavarian eclogite by Dr. Gerichten.—On a method of analysing crystalline minerals, by the same.—On a titaniferous iron of abnormal composition, by the same.—On abnormal constituents of urine after taking asparagus, by A. Hilger.—The solubility of tellurium and selenium in sulphuric acid, by the same.—On the quantitative determination of iodine in urine, by the same.—"Synthesis of Phenylbutylene" is the title of a lengthy paper by B. Aronheim. The author has also accomplished the synthesis of napthalene.—Under the heading, "Researches from the Chemical Laboratory of Kasan, communicated by Alexander Saytzeff," we have the following papers:—On an isomeric pyrotartaric acid, by A. Tupoleff. The acid is ethyl-malonic acid.—On the ether of monobrombutyric acid, by the same.—On some sulphur derivatives of the primary butylic alcohols, by N. Grabowsky and Alexander Saytzeff.—On the reduction of succinyl chloride, by A. Saytzeff. The chief product of the reduction is succinic aldehyde  $\begin{array}{l}CH_2COH\\ |\\ CH_2COH\end{array}$ which, by the action of caustic bases, yields a new oxybutyric acid  $\begin{array}{l}CH_2CH_2OH\\ |\\ CH_2COOH\end{array}$.—Contributions towards the determination of the structural formulæ of the allyl compounds of acrylic acid, by E. Linnemann.—Contributions to the history of the orcins.—IV. On the iodo-derivatives of the orcins, by John Stenhouse. This paper has already appeared in the Proceedings of the Royal Society.—Researches on the allyl group.—XIII. On α-dibrompropionic acid, by O. Philippi and B. Tollens.—XIV. On α-monobromacrylic acid and conversion of α-dibrompropionic acid into the β acid, by the same authors.—XV. On β-monobromacrylic acid from β-dibromproprionic acid, by R. Wagner and B. Tollens.—XVI. Bye-products of the preparation of β-monobromacrylic acid, by the same.—F. Mohr contributes a lengthy paper on the theory of dissociation or thermolysis. Among other views the author opposes in severe terms that of Horstmann, who has introduced the idea of entropy into the theory of dissociation.—The concluding paper is by J. J. van Renesse, On octylic and caprylic acids.

Bulletin de l'Academie Royale des Sciences, &c., de Belgique, sér. 2, t. xxxvii., No 4.—Mr. A. Gilkinet gives the first of a promised series of papers on the morphology of the Pyrenomycetes. This instalment of twenty-three pages with two plates is occupied with *Sordaria fimicola* (Cesati and De Notaris), which he identifies with *Sphaeria equina* (Fuckel). His observations confirm those made by M. Woronin on *Sordaria fimiseda*, showing that these fungi are sexual. The development and structure of the male and female organs are minutely given.—Dr. F. Putzeys contributes a paper On the centres of vaso-motor nerves. Where are the nerve-centres which affect the tonicity of blood-vessels? is the question he endeavours to solve. His experiments made upon a frog are carefully detailed. He shows that its spinal marrow possesses a reflex vaso-motor power throughout its entire length, thus confirming the work of Schlesinger, Goltz, Freusberg, and Vulpian. Until lately the tonicity of blood-vessels was believed to be under the control of the medulla oblongata alone.—There is a short note by M. Edward Morren, On the application of the mechanical theory of heat to the growth of plants. M. Barthélemy, Professor of Physics at Toulouse, had recently said that he noticed last July a bamboo in the Jardin des Plantes at Montpellier, which grew a centimetre an hour. Such growth, he remarked, must be coincident with the fixture of carbon. M. Morren by no means sees that this follows. He says, "Carbon fixed in the green organs of plants under the influence of the sun's rays, by the decomposition of carbonic acid, is not immediately applied to the formation of the tissues by which new organs are formed. The materials of growth are furnished by organic material already elaborated, and their application to the requirements of growth is accompanied by an expenditure of force requisite for their circulation and transformations." Often when we can see plants growing they are not fixing any carbon. Tubers, bulbs, buds, and seeds when sprouting not only do not fix carbon, but lose some. This is in consequence of their respiration, and it is the heat furnished by this combustion which occasions the motions by which they sprout.—There are four chemical papers by M. Louis Henry: On the dry distillation of lactic acid; On propargyl; On chloro-bromo-propionic acid; On glycerine derivatives.—There is also a note On systematic international meteorological observations.

Zeitschrift der Osterreichischen Gesellschaft für Meteorologie.—No. 8 of vol. ix. contains papers by Messrs. Wild, Hany, and Jelinek on methods of reduction to sea-level of barometric readings.—Dr. Ebermayer concludes his notice of Lorenz and Rothe's new "Handbook of Climatology." The second volume is by Dr. Lorenz alone. The "Provinces" into which he proposes to divide Europe are Subarctic, Pontic, Baltic, North and South Oceanic, and Mediterranean. The causes of modifications of climate are discussed and grouped according to their relative importance, and though the greater part is devoted to Europe, a short sketch of characteristics of climate of Asia, Africa, America, and Australia is given.—The space devoted to short articles is occupied with a notice of Bruhn's meteorological observations at Leipzic.

Astronomische Nachrichten, Nos. 1,991, 1,992.—These numbers contain a long paper by E. Schonfeld, giving the periods of maximum and minimum of a number of variable stars, with a short history of each. The elements of planet (136) are given as follows:—

Epoch April 1874, 0·0 Berlin time]

$$M = 225^\circ\ 29'\ 2''$$
$$\pi = 331^\circ\ 0'\ 0''$$
$$\Omega = 185^\circ\ 53'\ 4''$$
$$i = 11^\circ\ 30'\ 4''$$
$$\phi = 8^\circ\ 23'\ 2''$$
$$\mu = 1007''\cdot86$$
$$\text{Log. } a = 0\cdot36442.$$

Memorie della Societa degli Spectroscopisti Italiani, March.—This number contains a letter of Prof. B. Wolf, On the maxima and minima of solar spots. He refers to the value 11·111 years for the period, as given by him in 1852, and now finds from further data the period of minima to be 11·114 years, and that of maxima 11·060 years. He claims to have proved the connection between the above periods, and the magnetic and auroral disturbances. A diagram accompanies this number of the chromosphere, for Sept. 1872, and J. Tacchini contributes a paper On some spectroscopic considerations, in which he gives the method he employs for viewing the prominences with a tangential slit, accompanied by drawings.—To this number is an astronomical appendix, containing a paper by Prof. Schiaparelli, On the eleven-year period of the variation of terrestrial magnetism, considered in relation to the frequency of solar spots, to which is added a table showing at once the connection of the two phenomena, from the year 1836.

Der Naturforscher, April. This number consists of *résumés* of papers read before Societies, &c., most of which we have already noticed. Students of the Prehistoric period will find a long article from the *Mittheilungen der Antiquarischen Gesellschaft in Zurich,* on art workmanship of the reindeer period in Switzerland.

Bulletin de la Société d'Acclimatation de Paris, May.—A very practical paper on acclimatisation opens the May number, in which M. J. M. Cornély gives an account of his experiments in inducing kangaroos, wombats, llamas, marmots, Angora goats, and several new varieties of birds and plants to find a congenial home in the soil and climate of France. The former animals would seem to be fully acclimatised, and promise to be a valuable acquisition.—Brazil now seems to enter into the competition with new varieties of silkworms, which are described as possessing many qualities which will render them a most useful addition to the various silkworms now under cultivation.—The Society has been successful in securing two specimens of a fish called the Gourami, from Singapore; attempts have been made to procure some of these fish for introduction into this country, but they have as yet been unsuccessful. The introduction of the *Diospyros*, a Chinese fruit-tree, is recommended, and attempts are being made to acclimatise it.—M. Millet is endeavouring to secure some means of foretelling the approach of cold weather in the spring months, and asks for any observations on the point which others may have made.—An interesting paper by M. J. Lapru, on the Italian bee, points out the superior qualities of that insect, and suggests its more general cultivation.

Jahrbuch der kais. kön. geologischen Reichsanstalt. Band xxiii. Nos. 3 and 4.—The first paper in No. 3 is by Dr. O. Feistmantel On the relation of the Bohemian carboniferous formation to the permian. The palæontological and physical evidence enables the author to arrange these formations as follows:—I. Permian formations. *a* Upper group (with two stages) consisting of red sandstone with bituminous shales, containing animal remains, and red shales with various plant-remains; marl, limestone, and calcareous shales with abundant animal remains. *b* Lower group, or permanent coal-bearing group, containing coal-seams, generally accompanied with bituminous shales. The beds yield permian animal remains, and a rich flora almost entirely non-carboniferous. Red sandstones with *araucarites* are also included in the group. II. Carboniferous formation: grey sandstones and carboniferous shales; coal-seams without accompanying bituminous shales, and without a fauna which can be brought into relation or connection with the permian. The flora shows no admixture of permian types.—In the second article I. Niedzwiedzki gives some account of the basalt rocks met with in the carboniferous basin near Moravian Ostraw; and the other papers in the number are On the occurrence of Tertiary formations in the upper region of the Maritza valley, that is, between the Balkan and the Rhodope mountains in Rumili; and Contributions to the geology of the Fruska Gora in Syrmia.—There are only two geological papers in No. 4, the first of which is a very long contribution, by F. Posepny, On the lead and cadmia veins of Raibl in Carinthia, which is well illustrated with coloured lithographs, showing sections of various vein-stores, ores, minerals, &c., and a map of the workings, &c.—The second paper is by Dr. Mojsisovics, On some triassic fossils from the South Alps; two plates accompany the paper.—Among the "Mineralogical Communications," so carefully edited by Dr. Tschermak, there is one paper of somewhat general interest, An outline of a mechanical theory of the laws of crystallisation, by Dr. J. Hirschwald.

Verhandlungen des naturhist. Vereins d. pr. Rheinlande u. Westphalens, 29ter u. 30ter Jahrgang.—The former of these volumes contains, among other papers, one On Vesuvius, by Von Rath and Von Lasaulx; On the structure of Trilobites, by Von Koenen; On the effect of extreme cold on plants, by Mohr; On *Monas prodigosa*, by Prof. Binz of Bonn; On the pupil of the fox, by Troschel; On benzyl-sulpho-cyanates, by Kekulé; and others on technical points of medicine. In the latter we may note Dr. Braun's description of the Upper Jura, with a geological section; Dr. Umber's measurements of the skulls of numerous mammalia, in which he attempts to find a criterion of their intelligence in the proportion of the anterior to the posterior part of the basis cranii (according to his results the Carnivora are inferior to the Quadrumana; and Horses to Rodents and Marsupials); two papers on the geological and palæontological features of the cave at Balm: one by Rindfleisch On tubercular inflammation; and one by Kekulé On allyl compounds.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 11.—Note on the alleged existence of Remains of a Lemming in Cave-deposits of England, by Prof. Owen, F.R.S.

Note on the Absorption-Spectra of Potassium and Sodium at low temperatures, by H. E. Roscoe, F.R.S., and Arthur Schuster.

In order to obtain the absorption-spectrum afforded by the well-known green coloured potassium vapour, pieces of the clean dry metal were sealed up in glass tubes filled with hydrogen, and one of these was then placed in front of the slit of a large Steinhill's spectroscope, furnished with two prisms having refracting angles of 45° and 60°. The magnifying power of the telescope was 40, and was sufficient clearly to separate the D lines with one prism. A continuous spectrum from a lime-light was used, and that portion of a tube containing the bright metallic globule of potassium was gently heated until the green vapour made its appearance. A complicated absorption spectrum was then seen, a set of bands (α) in the red coming out first, whilst after a few moments two other groups appeared on either side of the D lines, the group β (less refrangible) being not so dark as the group γ. These bands are all shaded off towards the red, and in general appearance resemble those of the iodine spectrum. In order to assure ourselves that the bands are not caused by the presence of a trace of an oxide, tubes were prepared in which the metal was melted in hydrogen several times on successive days until no further change in the bright character of the globule could be perceived. On vapourising the metal, which had been melted down to a clean portion of the tube, the bands were seen as before, and came out even more clearly, the globule, after heating, exhibiting a bright metallic surface. An analysis of the potassium used showed that it did not contain more than 0·8 per cent. of sodium, although, of course, the double line D was always plainly seen.

In order to ascertain whether an alteration in the absorption-spectrum of the metal takes place at a red heat, fragments of potassium were placed in a red-hot iron tube, through which a rapid current of pure hydrogen gas was passed, the ends of the tube being closed by glass plates. The magnificent green colour of the vapour was clearly seen at this temperature on looking through the tube at a lime-light placed at the other end. Owing, doubtless, to the greater thickness or increased pressure of the vapour, the bands seen by the previous method could not be resolved by the small spectroscope employed, the whole of the red being absorbed, whilst a broad absorption-band in the greenish yellow was seen occupying the place of the group γ.

The positions of the bands obtained by the first method were measured by means of a telescope and distant scale, and the wave-lengths obtained by an interpolation curve, for which well-known air-lines were taken as references. The following numbers give the wave-lengths of the most distinct, that is, the most refrangible edge of each band. As the measurements had to be quickly made owing to the rapid darkening of the glass by the action of the metallic vapour, these numbers do not lay claim to very great accuracy, but fairly represent the relative positions of the band, and show that they do not always occur at regular intervals, although they are pretty regularly spread over the field, and all are shaded alike.

Bands of potassium shaded off towards red. Wave-length in tenth metre:—

6844	α	6459	α	6311	α	5949	β	5763	γ
6762		6430		6300		5930		5745	
6710		6400		6275		5901		5732	
6666		6379		6059	β	5860	γ	5712	
6615		6357		6033		5842		5700	
6572		6350		6012		5821		5690	
6534		6331		5988		5802		5674	
6494		6322		5964		5781		5667	

The bright potassium lines in the red and violet were not seen reversed, the intensity of the lime-light being too small at both extremes to render an observation possible.

In order to ascertain whether the vapour of sodium, which, when seen in thin layers, appears nearly colourless, exhibits similar absorption-bands, tubes containing the pure metal, which had been prepared and preserved out of contact with any hydrocarbon, were prepared, the metal being obtained free from oxide and the absorption-spectrum being observed in the manner already described. As soon as the metal began to boil a series of bands in the blue (Na γ) made their appearance, and shortly afterwards bands in the red and yellow (Na α), stretching as far as the D lines, came out. At this period of the experiment the D lines widened, thus blotting out a series of fine bands occurring in the orange (Na β), some of which could in consequence not be mapped. All the bands of the sodium-spectrum shade off like the potassium bands towards the red.

When the vapour of sodium is examined in a red-hot iron tube the colour of the lime-light as seen through it is a dark blue. As the sodium is swept away by the current of hydrogen passing through the colour becomes lighter, and the transmitted rays can be analysed by the spectroscope. At first the whole red and green and part of the blue is cut out entirely. The D lines are considerably widened, and an absorption-band is seen in the green, apparently coinciding with the double sodium line, which comes next in strength to the D lines. All the colours, therefore, seem to be shut out except part of the orange, part of the green, and the ultra blue. As the sodium vapour becomes less dense more light passes through, and the same absorption-bands are seen as are observed in the other method. The vapour then has a slight bluish-green tint, but is nearly colourless.'

The following numbers give the wave-lengths of the more refrangible edge of the sodium absorption-bands, in tenth-metres obtained in the manner above described :—

$$\left.\begin{array}{r}6668\\6616\\6552\\6499\\6450\\6405\end{array}\right\}\alpha \qquad \left.\begin{array}{r}6361\\6272\\6235\\6192\\6162\\6149\end{array}\right\}\alpha \qquad \left.\begin{array}{r}6105\\6092\\6071\\6051\\6035\\6016\end{array}\right\}\beta \qquad \begin{array}{l}5999\ \beta\\ \left.\begin{array}{r}5150\\5129\\5082\\5038\\5002\end{array}\right\}\gamma\end{array} \qquad \left.\begin{array}{r}4964\\4927\\4889\\4863\\4832\\4810\end{array}\right\}\gamma$$

The drawings accompanying the paper show the general appearance of the two absorption-spectra.

Linnean Society.—Anniversary Meeting, May 25.—G. Busk, vice-president, in the chair.—The chairman announced the officers who had been elected for the year (see NATURE, vol. x. p. 72).—It was moved by Mr. Busk, seconded by Mr. Carruthers, and carried unanimously :—"That the secretaries be requested to convey to Mr. Bentham the cordial thanks of the Society for his invaluable services throughout the thirteen years during which he has occupied the president's chair, to express to him the regret with which the Fellows contemplate the loss of his services, and to assure him that the zealous interest which he has taken in the welfare of the Society and the great efforts which he has made with so much liberality and success, to increase its prosperity and usefulness will always be held in grateful remembrance."—It was moved by Mr. Busk and unanimously resolved :—"That the thanks of the Society be also given to Mr. Stainton on his retirement from the office of secretary, with an expression of the Society's deep regret on losing his valuable services in that capacity."

June 4.—Mr. G. J. Allmann, president, in the chair.—The president exhibited a number of living specimens of fire-fly (*Luciola italica*) recently taken by himself in the neighbourhood of Turin, calling attention to the remarkable synchronous emissions of flashes of light by numerous individuals, and pointing out that the phosphorescence is a phenomenon not of darkness merely, but of twilight or night.—Prof. Thiselton Dyer described the structure of the flowers of *Pringlea* and *Lyallia*, which had recently been sent to this country for the first time by Mr. Moseley, from Kerguelen's Land, and which had been analysed by Prof. Oliver, and subsequently by himself. Dr. Hooker pointed out that several peculiarities in the structure of *Pringlea*, the absence of petals and of the usual glands between the bases of the stamens, the exserted anthers, and the papillæ of the stigma extended into a tuft of hair, appeared to point to this plant (a native of a country where there are no winged insects), being a wing-fertilised member of a class of plants that are ordinarily fertilised by insects.—The following papers were then read :—1. Contributions to the botany of the *Challenger* expedition. Presented by Dr. J. D. Hooker, C.B.—XIIa. *Challenger* Lichens (Cape de Verdes), by Dr. J. Stirton.—XVIIa. Letter from Mr. H. N. Moseley to Dr. Hooker, dated Cape Otway, Australia, March 16, On the botany of Kerguelen's Land, Marion, and Heard Islands.—XVIII. List of hitherto unrecorded species from Kerguelen's Land, Marion, and Heard Islands, with a note on *Lyallia kerguelensis* Hook f., by Prof. Oliver.—Synopsis of the mosses of the Island of St. Paul, by W. Mitten (Appendix to Dr. Hooker's paper On St. Paul's Island plants).—On the Restiaceæ of Thunberg's herbarium, by M. T. Masters, F.R.S. At the time that the author published his monograph On the South-African Restiaceæ, in the Journal of the Society, vol. viii. p. 211, and vol. x. p. 209, he had had no opportunity of examining the type specimens described by Thunberg. The few figures published by that naturalist are excellent; but his descriptions are often so imperfect that not even the sex of the plant is mentioned. In common therefore with all who had previously studied these plants, the author had to guess at the species intended by Thunberg. Lately, however, by the kindness of the authorities at Upsal, Thunberg's African collections have been transmitted to Kew for examination, and the author availed himself of the opportunity to study the Restiaceæ. The paper now read contains a list of these specimens with their names, synonyms, and such rectifications in the nomenclature as the examination rendered necessary.—On *Napoleona*, *Omphalocarpum* and *Asteranthos*, by J. Miers. The plants forming the small group of the *Napoleoneæ* are confined to two very heterogeneous genera, one from Africa, the other from Brazil. *Napoleona* was discovered in 1787 at Owaree, by Palisot-Beauvois; *Asteranthos* was established in 1820 by Desfontaines, when he associated it with *Napoleona* as a group belonging to *Symplocineæ*. These plants have been ever since a complete puzzle to botanists, who have assigned to them remotely dissimilar positions, the last being that given by the authors of the "Genera Plantarum," who make them a sub-tribe of Lecythideæ, one of their tribes of Myrtaceæ. A careful examination of these plants has convinced the author that most botanists have been wide of the mark in regard to their true affinity. Mr. Miers brought forward a large mass of information concerning *Napoleona*, from which he drew the conclusion that there is nothing in its structure to show the slightest relation to Myrtaceæ; that it is equally irreconcilable with the Barringtonieæ and with Lecythideæ; and in consequence of these negative results we must search elsewhere for its true affinity. This led the author to examine *Omphalocarpum*, a genus from the same region as *Napoleona*, and whose flowers and fruit of similar form grow upon the trunk of the trees. This genus has been generally regarded as belonging to Sapotaceæ; but the authors of the "Genera Plantarum" place it in Ternstrœmiaceæ. *Napoleona* cannot, it is true, belong to Sapotaceæ; but as it offers so many points of resemblance, and as it cannot find a place in any known natural order it must remain the monotype of a distinct family, to be placed in juxtaposition with Sapotaceæ. In regard to *Asteranthos* the author shows by analytical figures that it bears scarcely any resemblance in any of its features to *Napoleona*. A strong resemblance exists in the form of its calyx to that represented by Wight in an Indian species of *Rhododendron* And there seems nothing therefore to separate *Asteranthos* from other genera of Rhododendreæ, except its more rotate corolla.

Mathematical Society, Thursday, June 11.—Dr. Hirst, F.R.S., president, in the chair.—The president made a statement to the effect that he had much pleasure in announcing to the members present that he had received a letter from Lord Rayleigh in which that gentleman expressed his intention of handing over to the Society the sum of 1,000*l*. to be invested and applied to assist in the publication of the Proceedings, and the purchase of mathematical periodicals. As the subject will be brought before the members more fully in November next, no further action was taken, but the announcement of the munificent offer gave general satisfaction to the meeting.—Prof. Cayley, F.R.S., V.P., having taken the chair, Mr. S. Roberts gave an account of his paper On the parallels of developables and of curves of double curvature.—Lord Rayleigh next read a note On the numerical calculation of the roots of fluctuating functions.—In the absence of the authors, the secretary read parts of papers by Mr. Griffiths and Mr. Routh, F.R.S. In his note On a remarkable relation between the difference of two Fagnanian arcs of an ellipse of eccentricity e, and that of two corresponding arcs of a hyperbola of eccentricity $\frac{1}{e}$ Mr. Griffiths establishes the following relation: $\frac{\text{arc } PP_0 - \text{arc } QQ_0}{\text{arc } P^1P_0{}^1 - \text{arc } Q^1Q_0{}^1} = e^2 x x_0 \xi \xi_0$ where the unaccented letters refer to the ellipse and the accented letters to the hyperbola, and x, ξ, x_0, ξ_0 are the abscissæ of P, Q, P_0, Q_0. The object of Mr. Routh's first paper, viz. Stability of a dynamical system with two independent motions, will be gathered from the following extract :—"The equations of motion of a dynamical system performing small oscillations with two independent motions are of the form

$$A\frac{d^2x}{dt^2} + B\frac{dx}{dt} + Cx + F\frac{d^2y}{dt^2} + G\frac{dy}{dt} + Hy = 0$$

$$A^1\frac{d^2x}{dt^2} + B^1\frac{dx}{dt} + C^1x + F^1\frac{d^2y}{dt^2} + G^1\frac{dy}{dt} + Hy^1 = 0$$

To solve these we eliminate either x or y, and obtain a biquadratic of the form

$$aD^4 + bD^3 + cD^2 + dD + e = 0$$

The whole nature of the motion depends on the forms of the roots of this equation. Rules are given in books on the theory of equations to determine whether the roots are real or imaginary, but this is not exactly what we want to know. It is often important to ascertain whether the equilibrium about which the oscillation takes place is stable or unstable. The necessary and sufficient conditions for stability are that the real roots and the real parts of the imaginary roots should all be negative. It is proposed to investigate a method of easy application to decide this point."—Mr. Routh's second paper was On rocking stones, and a third was On small oscillations to any degree of approximation.

Anthropological Institute, June 9.—Prof. Busk, F.R.S., president, in the chair.—Sir John Lubbock, Bart., read a paper On the discovery of stone implements in Egypt. The author began with a sketch of the writings and opinions of M. Arcelin and Dr. Hamy, who maintained that the flint implements found along the valley of the Nile, including a hatchet of the St. Acheul type at Deir-el-Bahari, indicated the existence formerly of a true stone age there as in Western Europe. MM. Mortillet and Broca concurred in that view.—On the other hand Dr. Pruner-Bey, and especially Dr. Lepsius, had expressed the opinion that most of the objects described, such as the flint flakes, were naturally produced. M. Chabas also took the same view as Dr. Lepsius, and denied the existence of any evidence of a stone age either in Egypt or elsewhere. On the occasion of a late visit to Egypt with the object of getting conclusive personal evidence on the question, the author found worked flints at various spots along the Nile Valley, especially in the valley of the tombs of the kings of Thebes, and at Abydos, and after carefully weighing the facts and arguments brought forward by MM. Lepsius and Chabas, he was disposed to agree with MM. Arcelin and Hamy in considering that these flint implements really belonged to the stone age, and were ante-Pharaonic. Sir John exhibited a full series of the Egyptian flint implements found by himself during his visit, and the paper concluded with a minute description of each specimen.—Prof. Owen, F.R.S., then read a paper On the ethnology of Egypt. Since the observations recorded in 1861, by Dr. Pruner-Bey, on the race-characters of the ancient Egyptians, mainly based on the characters of skulls, evidences, in the author's opinion, of a more instructive kind have been discovered, chiefly by M. Mariette-Bey. They consist of portrait-sculptures, chiefly statues, found in tombs accompanied by hieroglyphic inscriptions revealing the name, condition, and date of decease. A study of those works led to the conclusion that three distinct types were indicated. (1) The Primal Egyptian, bearing no trace of negro or Arab, but more nearly matched by a high European facies of the present day. (2) The type of the conquering race of Shepherd Kings, or Syro-Arabian, exemplified in the Assyrian sculptures. (3) The Nubian Egyptian, typified in the bas-relief figure of Cleopatra in the Temple of Denderah. In conclusion, the professor drew a graphic picture of the high state of civilisation attained by the Primal Egyptian race, whose exquisite works, done six thousand years ago, are now rendered accessible to man. The paper was amply illustrated by a series of photographs, maps, and diagrams.

Royal Horticultural Society, June 4.—Scientific Committee.—A. Grote, F.L.S., in the chair.—The Rev. M. J. Berkeley exhibited trusses of Pelargonium "St. George," in which all the flowers, and not the central one only, were destitute of spur, thus presenting an illustration of what is termed regular Peloria, and approximating to the genus Geranium.—Messrs. Veitch sent a coffee-bush from Ceylon affected with a fungus, which overruns some 1,000 acres of plantation. This was probably the *Hemileia vastatrix*.—Mr. A. Murray alluded to the moth, *Pronuba yuccasella*, which has the habit of gathering the pollen of *Yucca*, and in so doing often fertilises the stigma.—Dr. Masters showed the roots of a Deodar, which had suddenly died after having been planted about fourteen years. On examination the plant was found infested by mycelium, and on further inquiry it was ascertained that the tree had been planted on the site of an old tan-pit, which had doubtless furnished the nidus for the spawn.—Prof. Thiselton Dyer read the following extract from a letter addressed to Admiral Spratt by his son:—"Dalhousie, Feb. 22, 1874.—On the night of the 10th of this month we had a change of white to blood-looking snow. The native mind was much excited, and said this falling of blood and snow was a sign of some coming great war. . . The blood and snow was snow mixed with dust. Now as the whole of the hills at the foot for some distance had been for many days well saturated, this dust must have come from a long distance, and must have ascended a considerable height. The snow-cloud must have been full of dust, or the atmosphere between us and it, probably the latter. The amount of discoloured snow was ¼" and the contents of one superficial foot 12¼ grains. Under the microscope it looked like small transparent laminations of mica or silica."—Prof. Thiselton Dyer communicated a note on the temperature of hill and dale.

General Meeting.—W. A. Lindsay in the chair.—The Rev. M. J. Berkeley commented on a new hybrid *Sarracenia*, raised between *S. flava* and *S. purpurea*, also on a plant of *Amorphophallus Berkeleyi*, found at Rangoon by his son Capt. Berkeley, and the stems of which were said to be sold in the Indian markets like asparagus.

Paris

Academy of Sciences, June 8.—M. Bertrand in the chair.—The president announced the death of M. Roulin, librarian to the Academy, and principal editor of the first volumes of the *Comptes Rendus*.—The following papers were read:—Determination of the number of similar triangles which satisfy four conditions, by M. Chasles.—On the distribution of the heat developed by collision, by M. Tresca. The author was led to this research by observing the production of oblique luminous streaks on the lateral faces of the platinum-iridium bar (described at the last meeting by General Morin) during the process of forging.—Several communications on vine-culture were read, all relating to *Phylloxera*. The first of these was by M. Dumas, entitled "Memoir on the means of repelling the invasion of *Phylloxera*." The author considers ammonium sulphhydrate the safest substance for the destruction of the pest without injuring the vine.—On the progress of the vine disease during winter. On the practical means of opposing the disease, by M. H. Marès. The author advocates likewise the use of ammonium sulphhydrate.—On the employment of carbon disulphide to repel *Phylloxera*, by M. le Baron de Chefdebein.—On the employment of sand in the treatment of vines attacked by *Phylloxera*, extract from a letter from M. J. Lichtenstein to M. Dumas. It appears that the insect cannot make way through sand owing to the loose nature of this substance. Since sand contains no fertilising principle, it is proposed to mix it with ashes and guano. The extract concludes with the following advice:—"Surround your stocks largely with sand, *Phylloxera* will not come, or, if there, it will perish and your vines will recover."—Prof. Cayley communicated a note entitled, "On a Formula of Unlimited Integration."—On the age and position of the Saint-Béat marble, a geological note, by M. Leymerie.—On the minute motions of a material system in stable equilibrium, by M. F. Lucas.—Modification of the commutator of Clarke's machine, by M. A. Barthélemy.—On friction in the collision of bodies, by Mr. G. Darboux.—On the lines of curvature of ruled surfaces, by M. E. Weyr.—Note on the spectrum of Coggia's comet (1874 III.), by M. G. Rayet. The spectrum is continuous from the orange to the blue (spectrum of the nucleus) and is traversed by three bright bands (spectrum of the coma) in the yellow, green and blue.—On the motion of the air in pipes, by M. Ch. Bontemps.—On a physiological peculiarity of Axolotl, by M. C. Dareste. The peculiarity in question is the presence of a mucous substance more or less red and containing blood corpuscles in the cloaca of both sexes during the period of reproduction.—On the metamorphoses of the *Acari* of the families *Sarcoptidæ* and *Gamasidæ*, by M. Mégnin.

CONTENTS

Page

Plateau on Soap-Bubbles. By Prof. J. Clerk-Maxwell, F.R.S. . . 119
Hinton's Practical Physiology . . . 121
Our Book Shelf . . . 122
Letters to the Editor:—
  Molecular Motion.—Prof. F. Guthrie . . . 123
  The Germans and Physical Axioms.—Chas. G. Root . . . 123
  The Long Peruvian Skull.—Dr. J. Barnard Davis, Prof. Jeffries Wyman . . . 123
  Lakes with two Outfalls.—E. S. Holden; S. W. Burnham . . . 124
  Palæotherium magnum.—W. Bruce-Clarke . . . 124
  The Telegraph in Storm-Warnings.—Fred. Norgate . . . 125
  Corydalis claviculata.—W. E. Hart . . . 125
Polarisation of Light, IX. By W. Spottiswoode, Treas. R.S. . . 125
Venus's Fly-Trap (*Dionæa muscipula*), II. By Dr. Burdon Sanderson, F.R.S (*With Illustrations*) . . . 127
Fertilisation of Flowers by Insects, VI. By Dr. Hermann Muller (*With Illustrations*) . . . 129
International Metric Commission at Paris. By H. W. Chisholm, Warden of the Standards . . . 130
Soundings in the Pacific . . . 131
Coggia's Comet. By J. R. Hind, F.R.S. . . . 132
Notes . . . 132
Scientific Serials . . . 135
Societies and Academies . . . 136

THURSDAY, JUNE 25, 1874

THE NEW PHYSICAL LABORATORY OF THE UNIVERSITY OF CAMBRIDGE

ON the 16th inst., at a congregation held in the Senate House, Cambridge, the Cavendish Laboratory was formally presented to the University by the Chancellor. The genius for research possessed by Prof. Clerk Maxwell and the fact that it is open to all students of the University of Cambridge for researches will, if we mistake not, make this before long a building very noteworthy in English science. We therefore put before our readers, as prominently as we can, a description of it.

The Cavendish Laboratory has been erected entirely at the expense of his Grace William Cavendish, Duke of Devonshire, K.G., Chancellor of the University, who has also signified his intention of supplying it with the apparatus necessary for a complete physical laboratory. The building consists principally of three floors, of which the accompanying figures show the plan on a scale of 32 ft. to the inch; Fig. 1 representing the ground-floor, and Figs. 2 and 3 the first and second floors respectively. The west front consists entirely of Ancaster stone; with the exception of the lecture-room and the staircase, which will presently be described, the only ornate portion of the building is the great gateway, X Fig. 1, situated near the south end of this front. The doors, which are very massive, are beautifully carved in oak, and bear, in old English letters, the inscription "Magna opera Domini exquisita in omnes voluntates ejus," which is the Vulgate version of Psalm cxi. 2. Over the gateway are the arms of the Duke of Devonshire on the left, and the University arms on the right, the motto of the Cavendish family, "Cavendo tutus," occupying the centre; and the whole is surmounted with a beautifully carved statue of the Duke in his robes as Chancellor of the University, and bearing in his hand the Cavendish laboratory. The lower portion of the building on the right of the entrance is occupied by the resident attendant. The external walls are 2 ft. thick, the foundation being at a depth of 15 ft. below the surface: with the exception of the west front, the tower, and the portion occupied by the lecture-room, they are built of brick, with Ancaster stone dressings. The tower (marked A in the plans), which is about 17 ft. by 14 ft. 6 in. internal measurement, and 59 ft. in height, contains a very handsome stone staircase with carved oak balustrades.

In describing the internal arrangements seriatim, we shall commence with the room at the east end of the ground-floor marked B in Fig. 1. This room is set apart for magnetic and other observations requiring great steadiness. At *a* is a brick pier about 18 in. high, with a stone top about 4 ft. square. This pier is quite distinct from the tiled pavement of the room, the brickwork being commenced at a depth of about 18 in. below the pavement, and this resting on a foundation of concrete about 18 in. thick. On this pedestal is placed the great electro-dynamometer of the British Association, the two large coils of which are each about half a metre in diameter, and each contains 225 turns of No. 20 copper wire. The diameter of each circle of wire has been accurately measured, as has also the distance betweeen the two bobbins, which is about equal to the radius of either. The resistance of each coil has also been determined, and thus all the electrical constants of this instrument are known with great accuracy. It is by comparison with these coils that the electrical constants of all the other electro-magnetic apparatus in the laboratory will be determined. For example, the magnitude and position of each circle of wire in each coil being known, the coefficient of induction of the first coil on the second can be at once found. Suppose, then, we wish to find the coefficient of induction of a third circuit upon a fourth whose resistance is known. Let the same primary current be sent through the first and third circuits, and let resistances be introduced in the second or fourth until the currents in the two latter are equal. Then the electromotive forces in the second and fourth circuits are proportional to the whole resistance in the circuits, and thus the coefficient of induction of the two pairs of circuits are compared.

At *b* and *c* are stone slabs each 4 ft. square, supported on foundations similar to those last described. On the slab at *b* is placed a unifilar magnetometer of the pattern adopted at Kew. In the upper part of the north wall of this room is a small window for the purpose of determining the direction of the meridian by astronomical observations. This direction being once determined, vertical mirrors will be placed opposite each other on the walls, each mirror being supported by three screws and accurately adjusted by means of nuts so as to serve the purpose of collimation marks. Three mirrors will be placed respectively on the north, east, and south walls of the room, but the fourth mirror will be fixed on the west wall of the room marked F in Fig. 1, in such a position as to be visible through the doorways from the mirror on the north wall of room B. The room marked C in Fig. 1 is called the clock room. In it is a stone pier, *d*, on foundations separate from the rest of the building and intended to carry the principal clock. This clock will be in electric communication with the other clocks in the building, and will from time to time be compared with the clock at the Astronomical Observatory. In this room is also erected a massive stone frame, *e*, intended to carry an experimental pendulum. This, like the clock pedestal, is erected on a foundation similar to that which supports the electro-dynamometer.

Each of the rooms B and C is about 30 ft. by 20 ft. The windows in all the rooms throughout the building have wooden shutters fitted to them, by which they can be completely darkened. On the inside of each window is a large stone shelf, and on the outside a similar shelf in the same plane with it, so that an instrument may be erected with some of its feet inside and some outside the window, a small channel being left between the two to allow the escape of rain-water. The room marked E in Fig. 1 has two large windows on the north side, and will be used exclusively for balances. The best balance at present in the laboratory was constructed by Oertling, and when loaded with a kilogramme in each pan will turn to the weight of a milligramme. This balance, while capable of carrying a very considerable weight, is sufficiently delicate for most physical purposes.

The room marked F in Fig. 1 is called the heat room; in it will be conducted experiments in calorimetry, and the like. This room at present contains an apparatus devised by Prof. Clerk Maxwell for determining the viscosity of air.* This is done by causing three glass plates to vibrate between four parallel fixed plates in an air-tight receiver, by means of the torsion of a steel wire. A mirror being connected with the plates, the amplitude of vibration is determined by viewing through a telescope the image of a fixed graduated scale formed by the mirror. The room G on the ground-floor is used for unpacking apparatus, &c., which is brought directly into this room from the street. The apparatus is then raised to the floor above by means of a lift at *k*. H Fig. 1 is used for a workshop; it is furnished with a carpenter's bench and tools, two vices, &c. A 5-inch self-acting screw-cutting lathe will shortly be added, and thus the means will be provided for adjusting and repairing on the premises most of the apparatus required in physical research. The room K is called the battery room; it is situated immediately under the lecture-room, into which wires will be carried from the battery through small hatches in the floor. The battery which will be employed is Sir William Thomson's tray battery, in which the zinc plates will be supported on porcelain cubes of 1-inch edge. The internal resistance of one of these cells is about ·16 ohm. A gas holder containing oxygen gas will also be kept in this room, from which pipes will be carried up into the lecture-room, so that the oxy-coal-gas limelight will be always at hand. The south wall of this room, which is 18 in. thick, passes up into the lecture-room independently of the floor, and carries the lecture table. The floor of the lecture-room is supported on two brick piers, which are built about an inch away from this wall. On the stone pavement of the ground-floor a long line will be carefully measured, and with this the other measures of length used in the laboratory will from time to time be compared. At *f* is an old stone gateway of the sixteenth century, which formerly served as the entrance to the Science Schools.

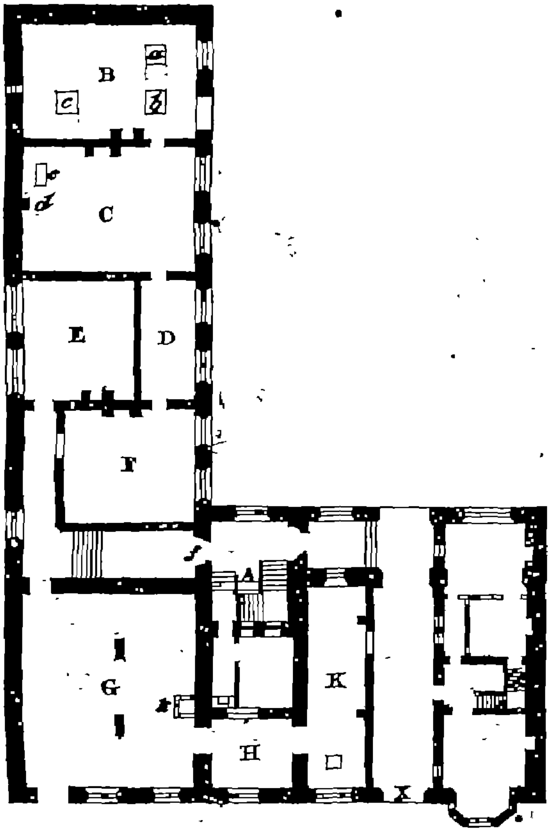


FIG. 1.—Ground Floor.

Passing now to the east end of the first floor we find ourselves in the general laboratory (L Fig. 2). This room is 60 ft. long and 30 ft. wide, and is designed to contain twelve large tables, though there are but ten in it at present. Each of the tables in this, as in all the rooms on the first and second floors, is supported independently of the floor on beams resting on brackets fixed in the walls of the rooms below, holes being left in the floor and blocks placed upon the beams so as to be flush with the flooring; it is on these blocks that the legs of the table rest. A stand-pipe, conveying gas, passes up through the centre of each table, and carries connections for four Bunsen or other burners, but can be removed at pleasure. A closet, provided with a good draught into the chimney, will be erected at the east end of this laboratory, in which any experiment producing objectionable fumes, &c., can be conducted. This laboratory is intended for the general use of students. Each room, with one or two exceptions, is provided with an open hearth for a basket fire and a ventilator leading into the chimney near the ceiling. Water is also laid on to all the rooms, which are likewise furnished with leaden sinks; and a plentiful supply of indiarubber tubing lined with canvas will be always on

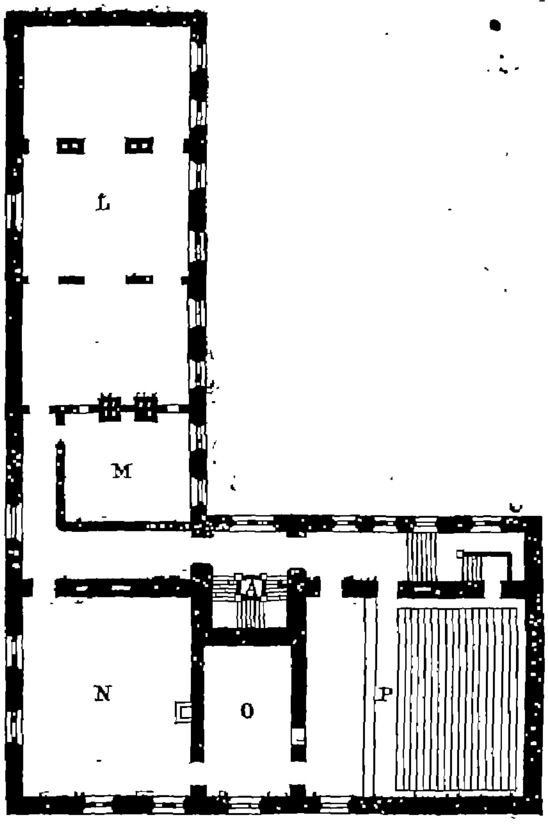


FIG. 2.—First Floor.

---

* See the Bakerian Lecture, Phil. Trans. 1866.

hand in case of fire. The room marked M in Fig. 2 is the Professor's private room. It communicates with the general laboratory by two hatches, which can be opened or closed at pleasure. In the south-west corner of this room is placed Sir William Thomson's quadrant electrometer, made by White of Glasgow. N Fig. 2 is called the apparatus-room. This room will be furnished with glass cases and cabinets, in which will be kept the apparatus which is not in immediate use, and amongst others several classical instruments belonging to the British Association, as for example the original standard unit of electrical resistance and the governor, coil, &c., used in determining this unit. The room O Fig. 2 is called the "preparation-room;" it communicates through a hatch with the lecture-room P. It is intended that the preliminary arrangements necessary for making experiments during the lectures should be carried out in this room. The lecture-room P is about 38 ft. by 35 ft. and 28 ft. high, and will afford accommodation for about 180 students. The lecture table, which extends throughout the width of the room, is of oak, and is supported on the top of an 18-inch wall as previously described. The seats for the class rise at an angle of about 30°, and there are three doors to provide sufficient means of egress for the audience. The room is panelled to a height of about 9 ft., above which the walls are brick relieved by handsome pillars, which spring from triple conical brackets, and support the ceiling. The room is lighted by three windows at a height of about 17 ft. from the floor, and one window below. Each window is furnished with wooden shutters, which fold together, thus completely darkening the room. The shutters of the three upper windows are opened and closed together by means of endless screws attached to a horizontal shaft which runs under each. The ceiling of the room consists of wooden panels, those near the walls being perforated and forming the bottoms of two horizontal shafts, which lead into a chimney, thus providing an efficient means of ventilation. Three of the panels over the lecture table, as well as the styles between them, can be removed. Above these are two strong tie-beams of the roof, from which Foucault's pendulum or other heavy bodies may be suspended over the lecture table. The panels and styles adjoining the north wall of the lecture-room can also be removed to allow of diagrams being suspended against the wall. On the other three sides of the room the ceiling does not abut directly upon the wall but is coved in the form of a quadrant of a circle, giving the room a very beautiful appearance. This lecture-room is in every respect a model room of its kind. All the rooms on the ground-floor and first floor, with the exception of the lecture-room, are about 15 ft. in height.

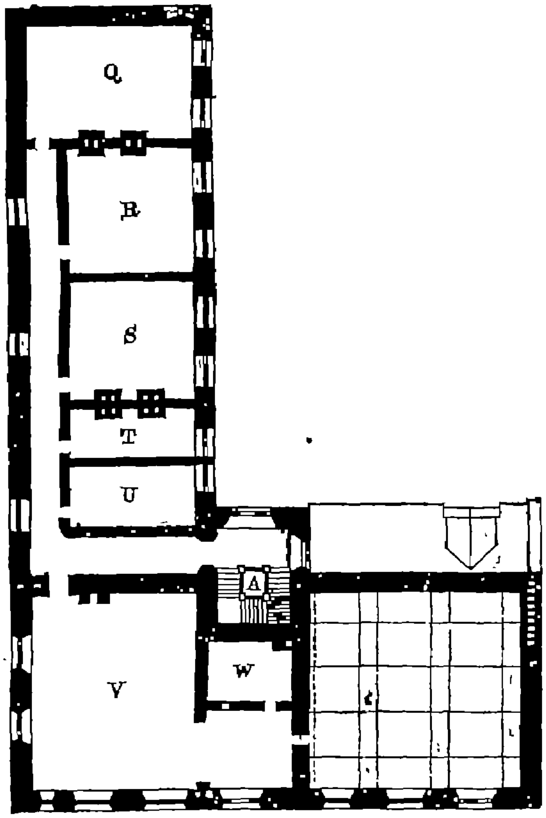


FIG 3—Third Floor.

On the third floor the room Q Fig. 3 is intended for experiments on acoustics. The room R will be employed for making drawings and calculations; S will be devoted to researches on radiant heat; and T and U are for optical experiments. V is the electrical room. The air in this room will be kept dry by Mr. Latimer Clark's contrivance, which consists of a heated copper roller over which an endless band of flannel passes. The roller is heated by gas-lights within it, and, being kept in constant rotation, every part of the flannel becomes heated in turn by passing over it. The vapour which rises from the heated flannel is carried off by the current of air which supplies the burners inside the roller, and escapes by the flue. The flannel when thus dried and cooled passes into the open air of the room, where it again absorbs moisture from the air, which thus becomes dried, so that the electrical instruments in the room are preserved in a highly insulating condition. From this room a small doorway enters the lecture-room at a height of about 17 ft. from the floor of the latter. An insulated wire connected with the prime conductor of the electric machine will pass through this doorway and thus supply electricity on the lecture table when the air in the lecture-room is too damp to allow of the satisfactory working of the machine. W is a small dark room for photographic and other similar purposes. A small window for a heliostat is placed in the west wall of the electrical room, opposite the door, from which a beam of light may be sent along the whole length of the building so as to allow of diffraction and other experiments, with rays of light 120 ft. in length. All the rooms are heated by hot-water pipes connected with a boiler in the basement. Near the east end of the building copper pipes are employed on each floor for the sake of the magnets in room B.

A lofty flight of steps in the tower leads from the second floor into the roof above the lecture-room, and a few more steps lead into the highest room in the building, which occupies the upper portion of the tower, its floor being more than 50 ft. above the ground. In this room will be placed a Bunsen's water pump, the water from which will thus have a vertical fall of considerably more than 50 ft. This pump will be used to exhaust a large receiver, from which pipes will communicate with the different rooms, so that if it be desired to exhaust the air from any vessel it will only be necessary to connect it with one of these pipes and *turn on a vacuum*. If a more perfect vacuum be desired than can be obtained by this means, the vessel may be subsequently exhausted by the Sprengel or other air-pump. A metal tube filled with mercury, with glass gauges on every floor for observing the height of the mercury within, will extend throughout the whole height of the tower and will serve as a manometer. The lower end of the tube will pass through the wall and terminate in F Fig. 1. On the top of the tower will be fixed a wooden mast carrying a pointed metal rod, for the purpose of collecting atmospheric electricity. The rod will communicate with the interior of the laboratory by an insulated wire.

The floors of the building are liberally supplied with hatches about 8 in. square, and in most cases those in the first floor are placed vertically under those in the second floor, so that wires may be suspended through the whole height of the building.

The laboratory was designed by Mr. W. M. Fawcett, M.A., of Jesus College, and the way in which he has turned to account the space available for his purpose, as well as the simple beauty of his designs have been the subjects of great admiration. Loveday of Kibworth was the contractor.

After the congregation on the 16th the Duke of Devonshire, Sir Bartle Frere, Sir Garnet Wolseley, Prof. Stoletow of Moscow, Prof. Balfour Stewart, Prof. Roscoe, and other distinguished visitors inspected the laboratory and expressed great satisfaction with the building and the arrangements.

Amongst the apparatus at present in the laboratory besides the electro-dynamometer of the British Association, may be mentioned the original B.A. units of resistance, together with the rotatory coil, speed governor, and bridge used in their construction; Sir William Thomson's quadrant electrometer, resistance coils up to 100,000 ohms (a megohm as well as some coils of very small resistance are expected shortly), three mirror galvanometers of different constructions, a 3 ft. 6 in. glass plate electric machine, and a 30 in. ebonite electric machine, Holtz's electric machine, and a hydraulic press, of a peculiar construction, made by Ladd and Co.

THE "CHALLENGER" IN THE SOUTH ATLANTIC

AT the last meeting of the Royal Society a letter from Prof. Wyville Thomson on board H.M.S. *Challenger*, to Admiral Richards, was read, which contained results of such high importance to biological science that were it the only result of the expedition England might have been proud to have had a hand in it. It is most interesting too as carrying on the story of the daily life on board ship which has been touched upon by Prof. W. Thomson in former communications to NATURE. The letter, which is dated Melbourne, March 17, starts by telling us that south of the line observations in matters bearing upon Prof. Thomson's department were made most successfully at nineteen principal stations, suitably distributed over the track, and including Marion Island, the neighbourhood of the Crozets, Kerguelen Island, and the Heard group.

After leaving the Cape, several dredgings were taken a little to the southward, at depths from 100 to 150 fathoms. Animal life was very abundant; and the result was remarkable in this respect, that the general character of the fauna was very similar to that of the North Atlantic, many of the species even being identical with those on the coasts of Great Britain and Norway.

Marion Island was visited for a few hours, and a considerable collection of plants, including nine flowering species, was made by Mr. Moseley. A shallow-water dredging near Marion Island gave a large number of species, again representing many of the northern types, but with a mixture of southern forms, such as many of the characteristic southern Bryozoa and the curious genus *Serolis* among Crustaceans. Off Prince Edward's Island the dredge brought up many large and striking specimens of one or two species of Alcyonarian zoophytes, allied to *Mopsea* and *Isis*.

The trawl was put down in 1,375 fathoms on Dec. 29, and in 1,600 fathoms on the 30th, between Prince Edward's Island and the Crozets. The number of species taken in these two hauls was very large, and many of them belonged to especially interesting genera, while many were new to science. There occurred, with others, the well-known genera *Euplectella*, *Hyalonema*, *Umbellularia*, *Flabellum*, two entirely new genera of stalked Crinoids belonging to the Apiocrinidæ, *Pourtalesia*, several Spatangoids new to science, allied to the extinct genus *Ananchytes*, *Salenia*, several remarkable Crustaceans, and a few fish.

The *Challenger* reached Kerguelen Island on Jan. 7, and remained there until Feb. 1. During that time Dr. von Willemoes-Suhm was chiefly occupied in working out the land-fauna, Mr. Moseley collected the plants, Mr. Buchanan made observations on the geology of those parts of the island which were visited, and Mr. Murray and Prof. Thomson carried on the shallow-water dredging in the steam-pinnace. Many observations were made, and large collections were stored.

Two days before the expedition left Kerguelen Island they trawled off the entrance of Christmas harbour, and the trawl-net came up on one occasion nearly filled with large cup-sponges belonging to the genus *Rossella* of Carter, and probably the species dredged by Sir James Clark Ross near the ice-barrier, *Rossella antarctica*.

The *Challenger* reached Corinthian Bay in Yong Island on the evening of the 6th, and all arrangements had been made for examining it, as far as possible, on the following day; but a sudden change of weather obliged Capt. Nares to put to sea. Fortunately Mr. Moseley and Mr. Buchanan accompanied Capt. Nares on shore for an hour or two on the evening of their arrival, and took the opportunity of collecting the plants and minerals within their reach.

The most southerly station was made on Feb. 14, lat. 65° 42′ S., long. 79° 49′ E. The trawl brought up, from a depth of 1,675 fathoms, a considerable number of animals, including Sponges, Alcyonarians, Echinids, Bryozoa, and Crustacea, all much of the usual deep-sea character, although some of the species had not been previously observed.

Prof. Thomson gives a list of the various classes of animals from Sponges to Teleostei, that were met with in nine successful dredgings, at depths beyond 1,000 fathoms, between the Cape and Australia. Many of them, Prof. Thomson states, are new to science, and some are of great interest from their relation to groups supposed to be extinct. This is particularly the case with the Echinodermata, which are here, as in the deep water in the north, a very prominent group.

During the present cruise special attention has been paid to the nature of the bottom, and to any facts which might throw light upon the source of its materials. This department has been chiefly in the hands of Mr. Murray; and Prof. Thomson gives the following extracts from Mr. Murray's notes :—

"In the soundings about the Angulhas bank, in 100 to 150 fathoms, the bottom was of a greenish colour, and contained many crystalline particles (some dark-coloured and some clear) of Foraminifera, species of *Orbulina*, *Globigerina*, and *Pulvinulina*; a pretty species of *Uvigerina*, *Planorbulina*, *Miliolina*, *Bulimina*, and *Nummulina*. There were very few Diatoms.

"In the deep soundings and dredgings before reaching the Crozets, in 1,900, 1,570, and 1,375 fathoms, the bottom was composed entirely of *Orbulina*, *Globigerina*, and *Pulvinulina*, the same species which we get on the surface, but all of a white colour and dead. Of Foraminifera, which we have not got on the surface, I noticed one *Rotalia* and one *Polystomella*, both dead. Some Coccoliths and Rhabdoliths were also found in the samples from these soundings. On the whole, these bottoms were, I think, the purest carbonate of lime we have ever obtained. When the soundings were placed in a bottle, and shaken up with water, the whole looked like a quantity of sago. The *Pulvinulinæ* were smaller than in the dredgings in the Atlantic. We had no soundings between the Crozets and Kerguelen.

"The specimens of the bottom about Kerguelen were all from depths from 120 to 20 fathoms, and consisted usually of dark mud, with an offensive sulphurous smell. Those obtained farthest from land were made up almost entirely of matted sponge-spicules. In these soundings one species of *Rotalina* and one other Foraminifera occurred.

"At 150 fathoms, between Kerguelen and Heard Island, the bottom was composed of basaltic pebbles. The bottom at Heard Island was much the same as at Kerguelen. The sample obtained from a depth of 1,260 fathoms, south of Heard Island, was quite different from anything we had previously obtained. It was one mass of Diatoms, of many species, and mixed with these a few small Globigerinæ and Radiolarians, and a very few crystalline particles.

"The soundings and dredgings while we were among the ice in 1,675, 1,800, 1,300, and 1,975, gave another totally distinct deposit of yellowish clay, with pebbles and small stones, and a considerable admixture of Diatoms, Radiolarians, and Globigerinæ. The clay and pebbles were evidently a sediment from the melting icebergs, and the Diatoms, Radiolarians, and Foraminifera were from the surface-waters.

"The bottom, from 1,950 fathoms, on our way to Australia from the Antarctic, was again exactly similar to that obtained in the 1,260 fathoms sounding south of Heard Island. The bottom at 1,800 fathoms, a little farther to the north (lat. 50° 1′ S., long. 123° 4′ E.), was again pure 'Globigerina-ooze,' composed of *Orbulinæ*, *Globigerinæ*, and *Pulvinulinæ*.

"The bottom at 2,150 fathoms (lat. 47° 25′ S., long. 130° 32′ E.) was similar to the last, with a reddish tinge, and that at 2,600 fathoms (lat. 42° 42′ S., long. 134° 10′ E.) was reddish clay, the same which we got at like depths in the Atlantic, and contained manganese nodules and much decomposed Foraminifera."

Mr. Murray, Prof. Thomson goes on to say, "has been induced by the observations which have been made in the Atlantic, to combine the use of the towing-net at various depths from the surface to 150 fathoms, with the examination of the samples from the soundings. And this double work has led him to a conclusion (in which I am now forced entirely to concur, although it is certainly contrary to my former opinion) that the bulk of the material of the bottom in deep water is in all cases derived from the surface.

"Mr. Murray has demonstrated the presence of Globigerinæ, Pulvinulinæ, and Urbulinæ throughout all the upper layers of the sea over the whole of the area where the bottom consists of 'Globigerina-ooze' or of the red clay produced by the decomposition of the shells of Foraminifera; and their appearance when living on the surface is so totally different from that of the shells at the bottom, that it is impossible to doubt that the latter, even although they frequently contain organic matter, are all dead. I mean this to refer only to the genera mentioned above, which particularly form the ooze. Many other Foraminifera undoubtedly live in comparatively small numbers, along with animals of higher groups, on the bottom."

It is very curious to note that in the extreme south the conditions were so severe as greatly to interfere with all work. "We had," Prof. Thomson says, "no arrangement for heating the work-rooms, and at a temperature which averaged for some days 25° F. the instruments became so cold that it was unpleasant to handle them, and the vapour of the breath condensed and froze at once upon glass and brass work. Dredging at the considerable depths which we found near the Antarctic circle became a severe and somewhat critical operation, the gear being stiffened and otherwise affected by the cold, and we could not repeat it often.

"The evening of Feb. 23 was remarkably fine and calm, and it was arranged to dredge on the following morning. The weather changed somewhat during the night, and the wind rose. Captain Nares was, however, most anxious to carry out our object, and the dredge was put over at 5 A.M. We were surrounded by icebergs, the wind continued to rise, and a thick snow-storm came on from the south-east. After a time of some anxiety the dredge was got in all right; but, to our great disappointment, it was empty—probably the drift of the ship and the motion had prevented its reaching the bottom. In the meantime the wind had risen to a whole gale, force = 10 in the squalls, the thermometer fell to 21°·5 F., the snow drove in a dry blinding cloud of exquisite star-like crystals, which burnt the skin as if they had been red hot, and we were not sorry to be able to retire from the dredging-bridge.

"The specific gravity of the water has been taken daily by Mr. Buchanan; and during the trip Mr. Buchanan has determined the amount of carbonic acid in 25 different samples—15 from the surface, 7 from the bottom, and 2 from intermediate depths. The smallest amount of carbonic acid was found in surface-water on Jan. 27, near Kerguelen; it amounted to 0·0373 gramme per litre. The largest amount, 0·0829 gramme per litre, was found in bottom-water on Feb. 14, when close to the Antarctic ice. About the same latitude the amount of carbonic acid in surface-water rose to the unusual amount of 0·0656 gramme per litre; in all other latitudes it ranged between 0·044 and 0·054 gramme per litre. From the greater number of these samples the oxygen and nitrogen were extracted, and sealed up in tubes.

"While we were among the ice all possible observations were made on the structure and composition of icebergs. We only regretted greatly that we had no opportunity of watching their birth, or of observing the continuous ice-barrier from which most of them have the appearance of having been detached. The berg- and floe-ice was examined with the microscope, and found to contain the usual Diatoms. Careful drawings of the different forms of icebergs, of the positions which they assume in melting, and of their intimate structure, were made by Mr. Wild, and instantaneous photographs of several were taken from the ship.

"I need only further add that, so far as I am able to judge, the expedition is fulfilling the object for which it was sent out. The naval and the civilian staff seem actuated by one wish to do the utmost in their power, and certainly a large amount of material is being accumulated.

"The experiences of the last three months have, of course, been somewhat trying to those of us who were not accustomed to a sea-life; but the health of the whole party has been excellent. There has been so much to do that there has been little time for weariness; and the arrangements continue to work in a pleasant and satisfactory way."

COLONIAL GEOLOGICAL SURVEYS

I.—CANADA

Report of Geological Survey of Canada for 1872-73.

RATHER less than thirty years ago the Canadian Legislature passed a vote for the institution of a Geological Survey of the province, with the object of ascertaining definitely the mineral resources of the country. In pursuance of this decision, the Governor-General, after some inquiry about a properly qualified individual to take charge of the Survey, finally appointed Mr. W. E. Logan, who, born in Canada, had made his name known in England by some careful surveys of the South Welsh Coalfield, and by original observations on the origin of coal. For thirty long years of unremitting labour, with obstacles of every kind, physical, pecuniary, political, the brave and sagacious director stuck to his post. Many a time with a legislature impatient for practical results in the discovery of minerals, and a ministry indifferent to science and bent on popularity by retrenchment of the budget, the chances of the Canadian Survey seemed desperate. But the pilot who guided its destinies showed himself as shrewd a judge of men, and as able to win them over, as he was a skilful pioneer in geology. And the result is that he has made the Canadian Geological Survey one of the first in the world, excellent in its equipment, considering the slender means placed at his disposal, and altogether admirable for the vast amount of solid work which it has accomplished—work which has not merely been of service to Canada, but has acquired a world-wide interest. In doing this he has made his own name a household word among geologists of every country. Canada may well be proud of her Sir William Logan.

About four years ago, having toiled so long and hard, he felt compelled to relinquish his post and seek the rest which his old age so needed and deserved. He was succeeded by Mr. Alfred R. Selwyn, who had been trained in the early days of the Geological Survey under Sir Henry De la Beche, had done much excellent and difficult geological work in Wales, and had thereafter held for a number of years the post of Director of the Geological Survey of Victoria. The Victorian authorities in 1869 suppressed their survey. When Mr. Selwyn lost that appointment, he was induced to accept the guidance of the establishment in Canada. There could hardly have been found a fitter successor to Sir William Logan. Long experience in all the details of geological surveying, both in civilised and in still unexplored regions, must have made it an easy matter for Mr. Selwyn to adapt himself to Canadian modes of exploration. He was renowned in his old Welsh days for his prowess as a mountaineer, and to judge from the present report the advance of years has not perceptibly impaired his bodily activity and powers of endurance. During the comparatively brief season when geological reconnaissances are possible in British North America he is found at one time away in the far east of the dominion inspecting mines in Nova Scotia, at another time with his colleagues and Indians laboriously toiling through river, lake, and portage, in the still only partially explored regions towards Fort Garry, or camping out for many weeks on the shores of Lake Superior. During 1872 the operations of the Canadian Survey under his charge extended across the whole breadth of North America at its broadest part, that is from the Queen Charlotte Islands to the headlands of Nova Scotia—a distance, in a straight line, of considerably more than 3,000 miles.

The success of such a service as that of the Canadian Geological Survey must depend, however, in large part on the calibre of the men who act under the director. And Mr. Selwyn is fortunate in his staff, which is nearly the same as that under Sir William Logan. Of his explorers in the field Mr. R. Bell and Mr. James Richardson have done much of that sound work on which the reputation of the Canadian Survey rests. To Mr. Billings, who determines his fossils, and to Dr. Dawson, who, though not attached to the Survey, generously lends his assistance in the palæontological department, the Survey is likewise largely indebted. As an analyst of minerals and ores and an able writer on chemical geology Sir William Logan had a tower of strength in Dr. Sterry Hunt, who has lately accepted an appointment in the United States. Dr. Hunt's successor, Dr. Harrington, carries with him into his new duties the good wishes of all geologists who take interest in the pursuit of mineralogy and petrography and in the perplexing problems of metamorphism. One of the oldest and best of Sir William's staff, Mr. Murray, has now an independent sphere of work in Newfoundland. He has issued a number of reports, to which and to his other services we shall return on a future occasion.

Geological field-work in Canada differs very markedly from field-work in most other countries. Most of the districts over which the Survey is now extending are in great measure, or wholly, unexplored, some of them, indeed, having never been visited by a white man before the adventurous geologist attacked their rocks with his hammer. There being no roads, and the country thickly timbered, the rivers form the natural routes for exploration. Each member of the staff receives in the early summer his instructions as to the area to be surveyed during the five or six months at most when surveying is possible. Providing himself with birch-bark canoes, two or more white men as *voyageurs*, and a variable band of Indians as guides and portage carriers, likewise with provisions for the entire party for the whole season during which the tour is to last, he starts on his voyage of discovery. Of course in such regions he has either no map at all or some mere rough sketch, so that he needs to construct the topography as well as the geology of his charts. Ascending the river which has been chosen, the party halts each night at some favourable creek and sleeps under cloaks or skins upon the shore. Sir William Logan used to sleep in a sack on the beach of Lake Superior, with his head stuck out of the mouth of it, and after tucking himself in would sometimes need to creep out again to knock off the edge of some protuberant rock, and thus literally to smooth his bed with his hammer. Expertness as a shot forms a valuable qualification in one of these explorers, and enables himself and his comrades now and then to enjoy the luxury of fresh meat. Great trouble often arises with the Indian attendants. Sometimes they cannot be had at all, and when obtained are apt to depart at a moment's notice, leaving the white men to manage their journey as they best can.

The Report of the Canadian Survey for 1872-73 bears the stamp of the same thorough unostentatious work which has characterised the whole of the long series of Reports from 1843 downwards. In such a yearly summary of progress we cannot expect the completeness of a finished memoir. The observers merely chronicle what they have seen in the tracts visited by them. But on this account their Reports are probably all the surer an index to their powers of rapid observation and of grasping main features of geological structure. In this aspect Mr. Richardson's Report, On the coalfields of Vancouver and Queen Charlotte Islands, deserves high commendation. By the time he could get himself transported across the continent to San Francisco, and thence by steamer to the part of Vancouver Island where his explorations were to be made, it was the beginning of July, and the heavy rains began before the end of September. In spite of wind and wet, however, he stuck to his work, and after storing away his boat, tent, and camp-equipage for next year's service, set out once more on his long journey, and reached Montreal in the middle of December. During these few and interrupted months he added considerably to what was previously known regarding the secondary coalfields of that part of America, made a number of careful measurements of the thicknesses of the strata, and brought home many fossils, both plant and animal, new to science.

He found that the coal-bearing rocks lie upon a vast depth of older crystalline masses among which he detected fossiliferous limestones. This metamorphosed series he estimates at somewhere about 17,000 ft. in thickness. When the fossils were submitted to Mr. Billings, that able palæontologist found them too obscurely preserved to warrant a definite opinion as to their age. From his reference of some of the corals to such genera as *Zaphrentis*, and the occurrence of *Productus*, *Spirifer*, and *Fenestella*, the rocks would at least seem to be certainly Upper Palæozoic, though he does not go further than to suggest that they may be "either Permian or Carboniferous, more probably the latter." On this great metamorphic group the coal-bearing rocks rest unconformably. To these rocks Mr. Richardson assigns a thickness of 5,000 ft. They consist of various shales, sandstones, shell-bearing limestones, and conglomerates with intercalated seams of coal, very much resembling apparently some parts of our Carboniferous sections in Britain. Their geological position appears to be about the parallel of our Cretaceous and perhaps the upper part of our Jurassic series. Among the plants Dr. Dawson finds some forms of cypress and yew, cycads and ferns, with species of oak, birch, and poplar, and remarks that these fossils furnish additional evidence of a fact already noticed, "that in the Cretaceous period the generic types of American trees were as well marked as at present." Among the shells, Mr. Billings finds 16 species of Ammonites, 2 of Belemnites, a Nautilus, 4 Gasteropods, and 9 genera of Lamellibranchs, the general facies of the whole being decidedly Cretaceous and Upper Jurassic. He admits the view of the States geologists to be substantially correct, that the coal of Vancouver Island belongs to one of the Cretaceous groups which is developed in northern California and Oregon. At the same time the fossil evidence suggests that while the Vancouver beds may be Upper Cretaceous, those of the Queen Charlotte Islands are partly Lower Cretaceous and partly Upper Jurassic. From the fact that the fossils in the Cretaceous formations on the west side of the Rocky Mountains are specifically different from those on the east side, Mr. Billings suggests the former existence of a land-barrier down the American continent on which the abundant Cretaceous flora flourished.

The route followed by Mr. Bell, of which an account is given in this Report (On the country between Lake Superior and Lake Winnipeg), presented comparatively little of general interest, though it gave scope for the same methodical and careful work for which his previous reports are distinguished. One fact deserves notice among his remarks, namely, that he has confirmed his previous observations of a great conformable series of metamorphosed Huronian rocks resting upon the Laurentian gneiss. Mr. Selwyn suggests that the conformability may be only local and deceptive. This is certainly a matter deserving attentive examination. Mr. McOuat contributes a well-written Report on the country between Lakes Temiscamang and Abbitibbe, where he was busy tracing the relations of some of the metamorphic rocks there to those on Lakes Huron and Superior. Mr. Ven-nor's Report deals with a more civilised part of the country, which had already, to some extent, been examined by the Survey. He is evidently an accession of great strength to the staff.

While explorations were in progress on the shores of the Pacific among the Vancouver coalfields, other members of the Survey were busy on the Atlantic borders among the coalfields of New Brunswick and Nova Scotia. Prof. Bailey and Mr. Matthews have written a valuable account of the New Brunswick region, which it is to be hoped will be extended and published with sections and fuller details. Several other Reports are included in the volume, having more of a practical than a scientific interest. In fine, the Geological Survey of Canada may be congratulated upon the evidences of continued activity which this volume furnishes. The form of such Annual Reports necessarily precludes a systematic treatment of the subject, and makes it somewhat difficult for readers unfamiliar with the localities to grasp the main features of geological importance amid the manifold local details. It is earnestly to be wished, therefore, that before many years pass away another general volume may be issued like that which Sir William Logan published eleven years ago.

ARCH. GEIKIE

(*To be continued.*)

OUR BOOK SHELF

Field Ornithology. By Dr. Elliot Coues. (Naturalists' Agency, Salem.)

OUR ornithological readers are all familiar with Dr. Coues' excellent "Key to North American Birds," which we noticed on its appearance. In that work it was intended that instruction in the best means of collecting and preserving birds should have been incorporated, which was prevented by the unexpected dimensions which the volume assumed. The same author now gives us these important instructions in a separate small manual, with which he combines a check list of the species described in the "Key," arranged in accordance with his own views, as a supplement to the larger work. The subjects treated of will be found of great service to all collectors, especially to those, both amateur and professional, who are commencing to attempt the accumulation and the preservation of bird-skins. The hints on the selection of a gun, shot, &c., will be of especial service to all sportsmen of small game, whilst the carefully-written account of the best way in which the skinning of birds, both large and small, should be undertaken, will well repay the perusal, even of the experienced. The various less well-known means of preserving specimens, as in spirit, and by means of carbolic acid, which latter is not inaptly termed by the author "mummification," are described in detail. Of the carbolic-acid method it is remarked: "I mention the process chiefly to condemn it as an atrocious one; I cannot imagine what circumstances would recommend it, while only an extreme emergency could justify it. It is further objectionable because it appears to lend a dingy hue to some plumages, and to dull most of them perceptibly." Notwithstanding these disadvantages there is one point which recommends this process, it being that the bodies of the birds preserved by it are in a condition quite fit for the dissection of the muscles and other organs, after they have been soaked for some time. Nothing is more difficult than for the students of internal structure to get most of the bodies of which they despondently regard so many skins; and they naturally look with delight at any method which gives them a chance of obtaining the species they desire. The check list will be found of much use to those who collect the birds of North America. It is printed on one side of the page only, and separate copies are to be printed, which can be cut up for cabinet purposes. For those who are commencing ornithology practically we know no book which will prove so serviceable as Dr. Coues' little work.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Proposed Issue of Daily-Weather Charts of Europe and the North Atlantic

I HAVE the honour to inform you that Capt. Hoffmeyer, Director of the Royal Meteorological Institute of Copenhagen, has sent me a circular announcing his intention to publish daily charts of the weather for the district from 60° E. to 60° W. long. and from 30° to 75° N. lat. The charts for the three months—Dec. 1873-Feb. 1874—will be published as an experiment.

The cost will be four francs per month, exclusive of postal charges.

Capt. Hoffmeyer states that he can only deal with central offices, and has requested me to undertake these islands as regards the distribution of the charts. I have therefore to announce that I have been instructed by the committee to subscribe for twenty-five copies of these charts, and I shall be happy to supply copies for the three months to any gentleman, at the cost of 11*s.* to cover carriage from Copenhagen, and postage from London to his address.

ROBERT H. SCOTT, *Director*

Meteorological Office, June 22

The Degeneracy of Man

DR. OSCAR PESCHEL, in his recently published "Völkerkunde" (p. 137), calls attention to a remark by the late Dr. von Martius, of much interest to anthropologists. It is well known that this distinguished naturalist avowed in the strongest terms his belief that the savage tribes of Brazil were the fallen descendants of more cultured nations. In 1838 he said:—"Every day I spent among the Indians of Brazil increased my conviction that they had once been in quite another state, but that in the lapse of dark ages there had broken in upon them manifold catastrophes, which had brought them down to their actual condition, that of a peculiar decline and degeneration. The Americans are not a wild race, they are a race run wild and degraded." To students of civilisation (myself for example) Dr. Martius' views have been most embarrassing. It was not strange that the theory of savages being the degraded offspring of primeval civilised men should have been advocated by Archbishop Whately, who did not even take the trouble to examine his own evidence. Nor is it surprising that the Bishop of Ely, in the "Speaker's Commentary," should still appeal to Whately as an unrefuted authority, for one hardly expects an orthodox commentator to test the arguments on his own side. But the case with Dr. Martius was quite different. Here was an eminent ethnologist, intimately acquainted with savage thought and life, declaring that it seemed to him not to indicate natural wildness, but to show traces of decay from an ancient higher culture. What made the matter more puzzling, was that Dr. Martius, in his researches, had come upon facts which he acknowledged to be evidence of progress taking place from savage toward civilised institutions. Thus, among the forest tribes of Brazil he found the rudest form of the "village community," with its tribe-land common to all, but the huts and patches of tilled ground treated as acquired private property, not indeed of individuals, but of families. It was manifest that these tribes were passing through stages of that very development of the law of real property which is so clearly shown in the history of European law. This is a strong argument in favour of the development-theory of civilisation, but how could an ethnologist who understood the force of such arguments, remain an upholder of the degeneration-theory?

Dr. Peschel considers that he did not so remain, but had changed his opinion when, nearly thirty years later, he wrote as follows as to the tribes of the vast region of the Amazons. "There are as yet no grounds for considering that the present barbaric condition in these districts is secondary, that any other higher social condition had ever here preceded it, that this swarming-ground of ephemeral unsubstantial hordes had ever been the theatre of a cultured nation."[*] It is to be noticed, however, that this passage does not seem necessarily to involve a recantation by Dr. Martius of his former opinion. He leaves it quite open that the tribes of the Amazons, though they did not degenerate in this region from civilised ancestors, might have done so elsewhere, and then migrated as savages into the forest regions where as savages they remain. The context may on the whole favour this view of his meaning. Now this matter quite deserves further looking into. It would be well worth while if Dr. Peschel, from personal or published sources available to him, would settle once for all the question whether the great Bavarian ethnologist continued through life the degenerationist that we in England suppose him to have been. Some twenty years ago, Dr. Prichard ("Natural History of Man," 1843, p. 497), citing Martius as to this very matter of the supposed fall of the South American tribes from an original higher state, remarked that "had he taken a more extensive survey of the nations of the whole continent, his opinion might have been somewhat modified." As Dr. Martius did take the more extensive survey thus recommended, it would be particularly curious to ascertain whether it did have the effect thus foretold on his mind.

EDWARD B. TYLOR

Flight of Birds

ALLOW me to return thanks to such of your correspondents as have been kind enough to notice the query (vol. viii. p. 86) on this subject which I made through your columns.

As the matter seems to have excited some little interest perhaps you will permit me to state in what respect the solutions proposed appear satisfactory.

That an "upward start" of wind of sufficient velocity would support a bird of given weight and surface of resistance is no doubt the case. As in still air a bird, by holding its wings in a plane slightly inclined to the horizontal, will glide with a velocity which ultimately becomes uniform, in a straight line obliquely downwards, so the same bird in the same position, but in a current slanting upwards in a like direction and with a like velocity, must remain at rest. Nevertheless there are difficulties in the way of thus explaining the phenomenon.

(1) It supposes the existence of air-currents of greater rapidity and at a greater angle of elevation than are likely often to be met with. Taking the number of square feet in the whole resisting surface of the bird to be equal to the number of pounds in its weight, then a *vertical* current of 15 miles per hour would be required to support a bird with its tail and wings fully unfurled but motionless, and a current of 30 miles per hour would be required if the current ascended at an angle of 30° with the horizon. Now wind directed upwards by encountering the side of a mountain is not likely to be inclined at a greater angle than this, which is the average slope of a very steep mountain side, and moreover the phenomenon of hovering without wing motion may be observed where such rapid currents have no existence.

(2) The phenomenon is sometimes observed where it is almost impossible to suppose the existence of any upward air-currents whatever. The first time it attracted my attention was in the neighbourhood of London, towards Finchley Common, where it will, I think, be admitted that there is nothing in the natural configuration of the ground to determine an upward current of sufficient velocity to produce the required effect. The wind at the time was certainly not boisterous, but as the bird was at a considerable elevation there is still room to imagine that the upper currents in which it was situated might be different from those below. I was informed at the time that the bird in this case was a kite; this may have been an error, as I understand that kites are now rarely seen near London. However this may be I should gladly hear from such of your correspondents as have the opportunity of watching the motions of the kite as to whether the position of motionless hovering, which I believe this bird continually assumes, can be explained always by the existence of upward currents. I do not of course deny but what birds, while hovering, avail themselves of upward currents where they can. If the position is the result of considerable though imperceptible muscular action they would naturally seek to economise their strength as far as possible by availing themselves of whatever support they could get from upward wind currents.

As your correspondent, J. Herschel, implies, it is difficult to dissociate the hovering and the soaring of birds. That birds soar, that is, that they continue suspended in the air for long periods of time together, in rapid motion, with no further apparent movement of the wings than is necessary to guide them, and this under circumstances where it is obviously impossible for them to avail themselves of upward air slants, cannot be denied. Whoever has made the voyage to the Cape must have observed this in the case of the albatross. This bird appears to rise from the sea with great difficulty and with the expenditure of much wing power; but, being once fairly launched in the air, its flight becomes a most inexplicable phenomenon. In the open ocean, during a steady wind, it soars for hours about a ship going at the rate of six or eight knots an hour, without apparent difficulty, and with no further wing motion than seems necessary to guide it, now skimming the water in the wake of the ship, now sweeping round to the side or in front, rising and falling by what has been well described as an apparent act of volition, and with no perceptible loss of velocity. Now I think it must be admitted that the motionless hovering and the soaring of birds are phenomena closely allied to each other, that no explanation of the one is satisfactory which does not explain the other also, and that, as the theory of upward slants cannot possibly explain the soaring of birds, it cannot be accepted as a satisfactory explanation of their hovering.

Besides the "upward air slant" theory, a correspondent of one of your contemporaries refers me to the Duke of Argyll's "Reign of Law" under the supposition that the matter is fully explained in the third chapter of that work. I only refer to this to point out the curious example it furnishes of fallacious reasoning. The author obviously thinks that, by a proper arrangement of its wings and tail and the position of its body, a bird can without muscular exertion remain suspended in a horizontal air-current, *provided the latter be of sufficient velocity* (see p. 170). This of course requires no refutation; but the whole of the chapter in which it occurs may be read with interest as illustrating the curious mistakes a clever and earnest amateur will fall into in writing on even the most elementary scientific subjects in which he has had no exact training.

F. GUTHRIE

Graaff Reinet College, Cape Colony

An Optical Delusion

THE following is an optical delusion which is none the less interesting for being very easily explained.

Let a person standing before a looking-glass look attentively at the reflection of the pupil of one of his eyes, and then at that of the other—let him look at different *parts* of the eye, and from one eye to the other, first at one and then at the other. Knowing that in thus changing the direction of his gaze his eyes *must* move about in their sockets he will expect to see that they do so in the glass. As a fact *they will appear perfectly still.*

If he looks at the eyes of another person trying the experiment, the peculiar fixedness of his own will be still more striking, when he looks at them again.

I will not spoil the riddle by giving the answer at the end.

J. H.

Longevity of the Carp

CAN any of your readers give any well-ascertained proof of the length of life attained by the carp? When residing as a youth at St. Germain, I was told by an aged Legitimist that his father had watched the same carp throughout the whole of his life, and the son asserted that he had known the identical fish for twenty and thirty years after his father's death, thus giving to them an age of from sixty to seventy years. That remarkable statement is more than substantiated by Lady Clementina Davies, who, in "Recollections of Society" (p. 49), alludes to the longevity of the carp in the moat of the Château de St. Germain, one bearing in his gills a ticket proving him to be over 200 years of age; and others at Versailles, bearing silver rings through their gills with the name of the courtier who had inserted it, and testifying to an almost incredible longevity. What amount of truth may we attribute to these statements?

Croydon, Surrey, June 13 ROBT. RODOLPH SUFFIELD

---

[*] Martius, "Beiträge zur Ethnographie Amerikas," vol. i. p. 375. The other passages here referred to will be found in the same volume, pp 5, 83.

LE GENTIL'S OBSERVATION OF THE TRANSIT OF VENUS

As all the world is now thinking of the transit of Venus, an episode of old time in connection therewith should be very interesting.

In a series of articles by M. W. de Fonvielle in *La Nature*, from which the accompanying illustration is taken, some interesting facts are given concerning Le Gentil's observations of the transit of Venus in the open sea about the middle of last century. These we reproduce here with some supplementary information from Le Gentil's own interesting work referred to below. His voyages extended altogether from 1760 to 1771. They consequently commenced before the transit of 1761, and were continued after that of 1769.

The expeditions of Le Gentil, the account of which, published by the royal press, fills two magnificent volumes, have left an ineffaceable mark upon the history of astronomy. His work is a proof that a man of energy and perseverance who sets himself to the solution of a great and beautiful problem can find, in spite of all obstacles, the means of immortalising himself. Posterity certainly owes some indemnification to the indefatigable astronomer, since his determination to solve scientific questions was undoubtedly prejudicial to his interests, and even to his love-affairs.

A pupil of De l'Isle, Le Gentil was intended for the church by his family, whose home was at Coutances, where he was born Sept. 12, 1725; but his attachment to Mlle. Potier, belonging to one of the richest families of Cotentin, made him give up all idea of so very celestial a profession. A happy marriage, contracted in 1771, after eleven years of absence, enabled him to triumph over his enemies, who had taken advantage of his being far away to fill up his place in the Academy of Science, and against his relations, who had attempted to take possession of his property; he had to go to law to make them give up what they had taken. His death, which had been announced so often, was very nearly becoming a reality, for he was seized by a dangerous malady, which would have carried him off but for the affectionate care of his wife.

Transit of Venus observed on the open sea by Le Gentil in 1761.

The Duc de la Vrillière, Minister of State, entrusted with the distribution of *lettres de cachet*, was then Director of the Academy. Le Gentil, having received from his bureau the orders of the King, embarked in 1760 for the Isle of France, on board the *Berryer*, a vessel of the Indian Company, which carried fifty guns, and sailed in company of the *Comte-d'Artois* of sixty-four. On July 10 he arrived at the Isle of France. Le Gentil resolved to proceed to Rodriguez, where he did not know that Canon Pingré, who had left Paris after him, had arrived, to execute a mission which he had received from the Academy. The two astronomers would have unexpectedly met on that island, then almost a desert, if Le Gentil had not found at the Isle of France the *Sylphide*, a frigate sent to the help of Pondicherry, Le Gentil's original destination. He, full of ardour, did not hesitate to embark on board of this vessel. But the winds were adverse to the expedition, and the *Sylphide* wandered from March 25, 1761, to May 24, the sport of calms and of the irregular winds of the north-east monsoon. On May 24, when off the coast of Malabar, Le Gentil learned that Pondicherry had been taken by the English. It was then necessary to return to the Isle of France, where the *Sylphide* arrived only on June 23, after having touched at Point de Galle on May 30.

It was between these two stations that Le Gentil observed the transit of Venus, of which the following is his description, stripped of all extraneous details:—

"To observe the entry of Venus I employed an excellent objective of 15 ft. (French) focus, fixed to a tube composed of four pine planks which I had made sufficiently solid without being too heavy. To work it I got a small mast with a halliard fitted on the port quarter-deck. I saw that it was useless to attempt to notice the first moment of the entry of Venus, for I did not want to fatigue myself and run the risk of not being able to observe the total immersion. Indeed, I had sufficient trouble to fix the sun, on account of the movement of the ship.

"When Venus had half entered, or nearly so, on the disk of the sun, which I recognised by my reflecting quadrant, I attached myself, so to speak, to the telescope of 15 ft. to try to catch the moment of total entry. As my watch was none of the best, and as I could not take the height of the sun precisely at the moment when Venus appeared to me to be totally immersed, it occurred to me to make use of the sand-glass, by means of which the way of the vessel was measured, and I had by my side a man well up to turning the glass at the instant in such a way that it was impossible to have an error of more than a quarter of a second each time.

"The weather having become overcast, and the rain having shown itself, I did not think it would be possible to notice the exit of Venus. Consequently I did not cause the mast to be changed, as I ought to have done, for we had tacked since half-past 11.

"At 2 o'clock it cleared a little, and shortly after the weather cleared so that I could see Venus very distinctly with my green objective, and without the help of any other coloured glass, and I was not incommoded. I saw, from this observation, that it was not impossible for a person used to the movement of a vessel, and accustomed to the use of large instruments, to observe, especially when the sea is calm, the immersions of the satellites of Jupiter with a telescope of 12 or 15 ft., which would have a large field, and to determine the time of those immersions in the above manner; for I believe myself safe in asserting that I did not make from them from 15 to 20 seconds in time of error on an immersion of the first satellite of Jupiter."

The observations made under these extraordinary circumstances, give for the total immersion of Venus, 8h. 27m. 56¼s.; the commencement of the exit, 2h. 22m. 53s.; the total exit, 2h. 38m. 52⅓s., which gives for the duration, 6h. 10m. 55⅚s., and for the time taken by the diameter to cross the limb of the sun, 15m. 59s. As M. de Seligny had observed at the Isle of France the exit of Venus, Le Gentil formed, for the meridian of his observation, 88° 20′ 15″. The log-book gave 87° 14′ 0″.

As there was to be another transit of Venus on June 3, 1769, Le Gentil resolved to spend eight years in the southern hemisphere in wait for it. He had the devotion to carry this resolution into effect, spending his time in making a series of curious and interesting observations in the Mascarene Islands, Madagascar, Marianne Islands, the Philippines, and the coasts of India. He had fixed on Manilla as his place of observation, and reached it about August 1866, but he was ordered to return to Pondicherry. By what must seem a cruel fatality, this patient devotee of science, when the day of the Transit arrived, found his view of the sun completely shut out by clouds during the whole phenomenon, although for many days previous the sky had been cloudless. On the other hand, two friends whom he had left at Manilla were fortunate enough to witness the transit without obstruction. Le Gentil died on October 22, 1792.

ON THE TEMPORARY FADING OF SOME LEAVES WHEN EXPOSED TO THE SUN

FOR some time past I have taken much interest in this subject, since it at first seemed to indicate that chlorophyll in living plants could be decomposed by light in the same manner as when dissolved out from them by alcohol or other solvents. It also seemed to agree with the fact which I had established by comparative quantitative analysis, that leaves grown much exposed to the sun contain a relatively less amount of chlorophyll than those somewhat more shaded, in some cases even only one-third the quantity. My attention was first called to a diurnal change in the colour of a kind of moss commonly grown in hothouses, by Mr. Ewing, of the Sheffield Botanical Gardens, and subsequently to a similar change in a tropical species of maiden-hair fern, by Dr. Branson of Baslow. In both cases the colour of the fronds, after the darkness of night, was deep green, but after exposure to the bright sun of day it was a far paler and whiter green, which was again restored by the subsequent absence of light. I was particularly anxious to ascertain whether this change was due to a diminution in the amount of chlorophyll, but was unable to detect any well-marked difference by careful comparative quantitative analyses. I therefore came to the conclusion that, at all events in the case of the moss, the change in colour was due to some sort of mechanical alteration in the structure of the fronds, but did not examine the question more fully. The true explanation appears to be that adopted by Prillieux, who describes his observations in *Comptes Rendus*, t. lxxviii. p. 506. According to him and to the previous experiments of Famintzin and Borodin, exposure to bright light causes both granular and amorphous chlorophyll to collect together at the sides of the cells, instead of being more evenly distributed. The result of this is that a much larger relative proportion of white light is reflected, and the leaves or fronds appear of a paler and whiter green. These conclusions are thus in perfect agreement with my own quantitative analyses, and we may, I think, look upon this combined evidence of two independent methods as furnishing a satisfactory explanation of the greater part, if not of the whole, of the temporary change in colour.

H. C. SORBY

THE COMET

AFTER a very unusual amount of difficulty in the determination of the orbit I have succeeded in deducing a set of parabolic elements which appear to possess considerable precision. They are as follows:—

Perihelion passage, July, 8·83652 Greenwich M.T.

	° ′ ″	
Longitude of Perihelion ...	271 3 51·5	Mean equinox
„ Ascending node ...	118 43 25·5	July 0
Inclination to ecliptic ...	66 21 16·0	
Log. Perihelion distance ...	9·8298719	

Motion direct.

Our last observation, a very good one, gives this position:—

June 22, at 10h. 4m. 21s. M. T. at Twickenham.

R.A. ... 7h. 21m. 58·05s.

D. ... + 68° 9′ 34″·5

which compared with the above orbit (parallax and aberration allowed for) shows only the following insignificant differences—in R.A. − 2″; in D. + 14″.

This close agreement with parabolic motion is not favourable to identity of the comet with that of 1737, notwithstanding similarity of elements, but we must look to observers in the southern hemisphere to enable us to decide this point. The comet may certainly be there observed till October or November in the Antarctic circumpolar heavens.

The subjoined ephemeris will suffice to indicate the course of the comet, while it continues visible in our latitudes.—

AT GREENWICH—*Midnight.*

	R A h. m	N.P D ° ′	Distance	Intensity of light.
June 25	7 27·3	22 33	0·816	2·4
27	7 30·6	23 11	0·769	2·8
29	7 33·7	24 3	0·721	3·3
July 1	7 36·5	25 10	0·673	3·9
3	7 39·1	26 34	0·624	4·6
5	7 41·3	28 24	0·575	5·5
7	7 43·2	30 46	0·528	6·6
9	7 44·8	33 48	0·482	7·9
11	7 46·2	37 39	0·437	9·6
13	7 47·5	42 30	0·396	11·5
15	7 48·6	48 33	0·359	13·7

I have assumed the intensity of light on June 13 = 1.

The orbit of the comet makes a very close approach to that of the planet Venus. My last elements indicate for least distance of orbits . . 0·011.

For calculation of places after July 15 the following expressions for the comet's heliocentric co-ordinates referred to the equator, will be useful, in conjunction with X, Y, Z, of the *Nautical Almanac.*

$$x = r\,[9{\cdot}77492]\sin(v + 26^\circ\ 8'{\cdot}5)$$
$$y = r\,[9{\cdot}98665]\sin(v + 276^\circ\ 17'{\cdot}1)$$
$$z = r\,[9{\cdot}92408]\sin(v + 176^\circ\ 54'{\cdot}5)$$

J. R. HIND

Mr. Bishop's Observatory, Twickenham, June 23

The following additional information is taken from a letter by Mr. Hind in yesterday's *Times*:—

"The comet will be nearest to the earth on the night of July 22, its distance being then less than 0·3.

"Last night at 11.30, the moon being yet above the horizon, the comet appeared to be in the least degree fainter than the star Upsilon, Ursæ Majoris, which Argelander estimates rather higher than the fourth magnitude. In the strongly illuminated sky of these midsummer nights it was very sensibly brighter than the neighbouring stars 42 and 43 Camelopardi. By measures of the nucleus taken with the filar-micrometer, it appeared to be rather more than 4,000 miles in diameter, and the tail, assuming it to be projected from the nucleus in the line of the radius-vector, would be 4,000,000 miles in length.

"During the first fortnight in July the comet will undoubtedly be a pretty conspicuous object in the constellation Lynx, where there are few bright stars.

"At the end of September its brightness, by theory, should be the same as on the night of discovery (April 17), and it will then be well observed in the southern hemisphere, in the neighbourhood of the star Alpha Chamæleontis."

MR. HIND, in a letter with which he has favoured me, lays great stress upon the star-like appearance of the nucleus of the comet now visible, as seen in a telecope; and M. Rayet has already, in a communication to the Paris Academy, shown that its spectrum is continuous, that of the coma giving the three ordinary cometary bands. On Monday evening last the comet was bright enough, in spite of the moonlight, to enable me to observe this continuous spectrum with my 6¼ inch Cooke and a pocket spectroscope. It struck me that the spectrum was short, *i.e.* that it was deficient in blue rays; and as one saw in the telescope a fan-like structure above the nucleus (as seen in an inverting telescope), so also in the spectroscope, the continuous spectrum sparkled as if many short bright lines or bands were superposed upon it. I shall be glad to learn that other observers with more powerful instruments have had their attention directed to these two points.

J. NORMAN LOCKYER

NOTES

ON the 3rd inst. the corner stone of the American Museum of Natural History in New York was laid by the President of the United States. The ground belonging to the Museum measures about eighteen acres, and the building when completed according to plan will be larger than the British Museum. The object of the Museum is twofold:—First to interest and instruct the masses; and secondly, and specially, to render all possible assistance to specialists. The library presented to the Museum by Miss Wolfe, with a large collection of shells, also donated by Miss Wolfe to the Museum in memory of her father, who was its first President, was purchased by her at a cost of 35,000 dols. The other collections at present in the temporary Museum are valued at 250,000 dols. A rare and newly complete series of American birds, and many fine birds of Paradise and pheasants, now in the collection formerly belonging to Mr. D. G. Elliott, will be added. The Trustees have purchased the collection of Prince Maximilian, of Neuwied, on the Rhine, and a large number of specimens belonging to the late Edward Verreaux, of Paris. Large donations of shells, corals, and minerals, have been received, as also a collection of 20,000 insects. The collections will be bought and cared for by moneys contributed by the Trustees individually and the public, but the building now in progress will be erected at the expense of the city, which has already appropriated 500,000 dols. for this purpose.

Prof. Joseph Henry of the Smithsonian Institution gave an address on the above occasion, in which he spoke as follows on the necessity of endowing scientific research:—"The development of the institution would not be completed were it furnished with all the appliances I have mentioned. There is another duty which this city owes to itself and to the civilisation of the world. I allude to an endowment for the support of a college of discoverers and a number of men capable not only of expounding established and known truths, but of interrogating nature and discovering new facts, new phenomena, and new principles. The blindness of the public to the value of the abstract sciences and the matter of endowments of colleges for their support is remarkable. It is not everyone, however well educated he may be, that is capable of becoming a first-class scientist. Like poets, discoverers are born, not made, and when one of this class has been found he should be cherished, liberally provided with the means of subsistence, fully supplied with all the implements of information, and his life consecrated to the high and holy office of penetrating the mysteries of nature. What has been achieved in the knowledge of the forces in operation in nature, and the uses to which it is applied in controlling and directing these forces to useful purposes, constitutes the highest claim to the glory of our race.'

THE Duke of Devonshire, speaking at the banquet at Trinity College, Cambridge, on the 17th inst., said it had fallen to his lot during the last three or four years, while acting on a Royal Commission for inquiring into Scientific Education and the Advancement of Science, to become acquainted with the development and extension of scientific teaching in the several Universities of the kingdom, and of learning the views of those best qualified to express an opinion as to the requirements remaining to be supplied. The result of the inquiry had been satisfactory, inasmuch as it showed that a great deal had been done in the direction indicated, and that University authorities had manifested a strong desire that the Universities should be provided with all appliances necessary not only for centres of scientific education, but as centres also of general intellectual activity and of original research. This latter point was strongly insisted on in the evidence before the commissioners, and received their concurrence. A University which recognised the advancement and extension of knowledge as one of the main purposes of its existence was surely to be regarded as of a higher and nobler type than one which was satisfied with the position of a mere educational body. There was nothing antagonistic in these two objects; on the contrary, great advantage might be derived from their combination.

THE Emperor of Austria has been pleased to confer upon Mr. Robert H. Scott, F.R.S., the Director of the Meteorological Office, the Order of the Iron Crown, Third Class.

DR. TOLOZAN, physician to the Shah of Persia, has been elected a corresponding member of the French Academy in the section of Medicine and Surgery, and M. Studer of Berne in that of Geology. The latter is a veteran of 79 years.

THE organisation of the French National Observatory will very soon be complete, *Les Mondes* says. The French Government have voted 30,000 francs to the meteorological department, and M. Le Verrier is about to resume the work of international meteorology, with the fixed intention of abandoning local meteorology to the departmental observatory of Mont-Souris. M. Le Verrier is at present in this country, having come over to get his Cambridge degree conferred. He is to visit Newcastle, to inspect Mr. Newall's large telescope, and Edinburgh and Glasgow in connection with meteorology. The printing has been begun of a very large catalogue of stars observed at the Paris Observatory. MM. Fizeau and Cornu are measuring anew the speed of light under conditions which encourage us to look for a definite result.

THERE will be ample opportunities for practical work in Natural Science during the long vacation (July and August) at Cambridge. The laboratories of Experimental Physics, of Chemistry and Physiology, will be open, and the professors, or the demonstrators, or both, will be in attendance to give assistance to students. Prof. Newton has given notice of a practical class for Comparative Anatomy; and Prof. Humphry has given notice of a practical class for Human Anatomy (more particularly Osteology), and also for Histology.

THE Rev. S. J. Perry, the head of the expedition sent out by the Admiralty to observe the transit of Venus, together with Lieut. Coke, R.N., Paymaster Brown, R.N., and the Rev. W. Sidgreaves, were among the passengers by the steamer *Windsor Castle*, which left Dartmouth on Tuesday for the Cape of Good Hope.

THE *conversazione* of the Society of Arts held in the South Kensington Museum last Friday was a great success. It is said there were about 3,500 guests present.

AT the annual meeting of the Palestine Exploration Fund, Lieut. Conder, R.E. (officer in charge of the survey of Palestine), described the work of the expedition. Before leaving Palestine he had completed half the map, and it was expected that within four years, instead of eight, the whole of Palestine would have been surveyed. There were now 300 square miles added to the map, being five times the result at first expected to be accomplished.

THE discovery of a new planet by Mr. Perrotin, of Toulouse, is announced.

AT the half-yearly meeting of the Highland and Agricultural Society of Scotland, a long discussion took place in reference to the filling up of the vacancy in the chemical department, as also on the proposal for granting bursaries with a view to the encouragement of agricultural education throughout the country. It was ultimately agreed to remit the matter back to the directors, with instructions to inquire as to the amount of funds that could be placed at their disposal for the educational and chemical departments. A motion for memorialising Government on the propriety of establishing agriculture as a branch of the system of physical science taught under the superintendence of the Department of Science and Art, and proposing that the Society offer a premium for the best text-book for such a course, was adopted.

IN reliance on the receipt of further subscriptions to prosecute the Sub-Wealden Exploration, it has been decided to continue the boring to a farther depth of 200 ft. The hon. secretary has offered to become personally responsible to the Diamond Rock Boring Company for the cost of the extra 200 ft. His offer has been accepted, and he has been requested to issue another appeal for subscriptions. In doing so he urges upon "all who like to be considered generous, enlightened, wise, and good, to vie with each other in contributing to complete this the first boring for scientific purposes in England."

AT the Anniversary Meeting of the Royal Geographical Society on Monday it was stated that there had been an increase of 342 new membering and 9 honorary corresponding members; the Society now numbers 2,900 Fellows. In accordance with the announcement already made, the Founder's Gold Medal was presented to Dr. Georg Schweinfurth, in whose absence it was received for him by the German Ambassador Count Münster; and the Victoria (or Patron's) Gold Medal, which had been awarded to Col. P. Egerton Warburton, for his journey across the previously unknown part of Western Australia, was received by his nephew, Mr. Bateman. Mr. Francis Galton, F.R.S., then introduced the successful competitors for the annual geographical medals. A gold medal for physical geography was awarded to Louis Weston (City of London School), and a bronze medal for the same subject to Francis Charles Montague (University College School). For political geography, a gold medal was gained by W. H. Turton (Clifton College, Bristol), and a bronze medal by Lionel Jacob (City of London School). The president, Sir Bartle Frere, then delivered his address on the progress of geography, and announced as his successor in the presidential chair, Major-Gen. Sir Henry C. Rawlinson, K.C.B. Medals were also given to Chumah and Susi, two of Livingstone's black servants, who brought his MSS. to England. The Rev. H. Waller stated they were of invaluable aid to Mr. T. Livingstone in editing the MSS., both from their accurate knowledge of the country and their intelligent comprehension of the maps. At the anniversary dinner in the evening, among those who were present and who spoke were M. Leverrier and Chief-Justice Daley, President of the American Geographical Society.

THE fourth part of Tryon's "American Marine Conchology" has made its appearance, with eight coloured plates, and embracing the family of the *Chitonidæ*, of which six species are indicated, the orders *Opisthobranchiata* and *Pteropoda*, the commencement of the class *Acephala*, beginning with the *Pholadidæ*. The work was commenced early in 1873, and if it be confined to the five or six parts originally proposed, will soon be brought to a completion.

AT the annual distribution of the prizes in connection with the Newcastle College of Physical Science, on the 17th inst., the address of the Dean was, on the whole, very hopeful. The number of students has not greatly increased, but the quality of the work done has advanced considerably. We regret to see that the evening classes have not been so great a success as was hoped; but we hope the professors will not be easily induced to discontinue them, but will take every means to let their advantages be known to the young men of the district. During the past year the facilities of the college for imparting knowledge has been very much increased. The laboratory has been extended; a large and valuable collection of minerals has been added to Dr. Page's museum; and several expensive instruments have also been added to Mr. Herschel's collection. It is hoped that very soon a Chair of Biology will be established in the University. Arrangements have been made by which the degree of B.Sc. will be conferred on any deserving student by the University of Durham; and we are glad to see that the requirements for this degree have been made very considerable. Arrangements have also been made by which the college will be fully represented in the Senate of Durham.

A GEOLOGISTS' FIELD CLUB was instituted at Halifax at the close of the University lectures (Cambridge extension scheme) last April. The excursions which had been made from time to time with Mr. Sollas, B.A., made the students wishful to keep them up; hence the formation of a club which numbers about ninety members. The proceedings are reported in the local papers, and judging from the programme sent us the club means to go in for hard and earnest, and we hope fruitful, field-work.

IT gives us much pleasure to see from a recent number of the *Dunstable Borough Gazette* that that paper devotes a fair amount of space to science, under the title of "Our Science Column." The number before us, June 17, contains a good popular article on the value of scientific knowledge, some meteorological data, and an original communication on the botany of Dunstable, being the continuation of a list of plants of the district, with their common and scientific names. We hope the editor will continue his science column, and make it a means of enlightening his readers, and that the number of provincial papers which have a "Science Column" may go on rapidly increasing.

THE *Gardeners' Chronicle* learns that a committee has been formed, and funds are being collected, for the much needed restoration of Selborne Church as a memorial to Gilbert White. It is also proposed to erect a Cross to his memory on the "Plestor." It is hoped that a sufficient sum will be raised, beyond what will be required for these objects, to found an exhibition to one of the colleges at Oxford, with which he was connected, to be called the "Gilbert White" Exhibition. It is calculated that at least 5,000*l*. will be required. The committee includes the names of the Right Hon. Lord Selborne, the President and Fellows of Magdalen College, Oxon; Prof. Bell, F.R.S., &c.; the Rev. F. Parsons, Vicar of Selborne, and others.

AT a special meeting of the Anthropological Institute, to be held at Bethnal Green Museum, on July 1, Col. Lane Fox will give an Address on the principles of classification in his anthropological collection.

DR. LEA has added another volume to his large work on the Unionidæ, illustrated by twenty-two lithographic plates.

A PROPOSAL has been made in the *American Chemist* that a centenary meeting should be held on August 1 to commemorate the discovery of oxygen by Priestley on August 1, 1774. The *American Journal of Science and Arts* points out that this would afford an opportunity to discuss interesting chemical topics and to review the progress made during the century.

ON Wednesday the 17th the President of the Geological Society held an inaugural reception of the Fellows in their new apartments at Burlington House, to which many ladies were also invited. Although the meeting-room has been in use for a few weeks, and the removal of the library from Somerset House has been completed, the removal of the museum has but just commenced, and as the collections are so extensive it will occupy many weeks.

THE Statistical Society will hold its Fortieth Anniversary Meeting on Tuesday, June 30, at 3.30 P.M.

A PROJECT has been set on foot to provide Bridlington Quay with a marine aquarium. It is estimated the work will cost about 5,000*l*., towards which several gentlemen in the locality have promised to subscribe. The affair will probably take the shape of a limited liability company.

THE additions to the Zoological Society's Gardens during the last week include two Huanacos (*Lama huanaco*) and a Patagonian Cavy (*Dolichotis patachonica*) from Patagonia, presented by Mr. W. G. Parry; a Common Racoon (*Procyon lotor*) from North America, presented by Mr. T. Taylor; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. Wood; two Blue-cheeked Barbets (*Megalæma asiatica*) and two White Cranes (*Grus leucogeranos*) from India; a Honey Buzzard (*Pernis apivorus*), European, purchased; a Malay Tapir (*Tapirus indica*) from Malacca, deposited.

CONFERENCE FOR MARITIME METEOROLOGY

THE Sub-committee for Maritime Meteorology appointed by the Permanent Committee of the Vienna Congress have determined to hold a private conference on the subject in London, to commence on Aug. 31. The meetings will be held, by permission of the meteorological committee, at the Meteorological Office, 116, Victoria Street, London, S.W. The invitations are to be issued this week, and the following is the Programme of Questions to be discussed. I may say that I have already received replies to the circular respecting the Brussels Conference from all the countries to which it was addressed.

ROBERT H. SCOTT,
Secretary to the Sub-Committee

A general wish has of late been expressed that the measures for the prosecution of Maritime Meteorology proposed at the International Conference at Brussels in 1853 should be reconsidered, now that the experience of more than twenty years of the operation of these measures has enabled meteorologists to form opinions as to their utility.

At the Meteorological Conference at Leipsig in 1872, and again at the International Congress at Vienna in 1873, preliminary discussions took place on the subject of the more successful prosecution of Ocean Meteorology. Certain resolutions were adopted at Leipsig and confirmed at Vienna, and accordingly it seems proper to embody them in the present programme. They run as follows:—

"1. Thorough uniformity in methods and instruments should be aimed at in the same measure as for observations on shore. This will be most satisfactorily obtained by the chiefs of the central institutes—the establishment of which in all countries in which they do not already exist, and in which the maritime interests demand them, must be declared as absolutely necessary—entering into relations with each other and agreeing on the separate details, the construction of the instruments, the hours of observation, the journal, &c.

"2. Unity of measures and scales is desirable, and to this end the introduction of millimetres for the barometer and the centigrade scale for the thermometer should be aimed at. While, however, the comparison of standard instruments of the individual central stations must be insisted on, the uniformity of scales is at present only declared as desirable.

"3. The Committee would urge the importance of the co-operation of the navies, inasmuch as by their assistance, and by the opportunities afforded thereby of completeness in certain observations, the determination of factors and constants is rendered possible, which can be used with advantage for the reduction of certain results derived from the general system of observations.

"4. With reference to the utilisation of the results, the Committee would urge similarly the importance of uniformity in the methods employed. In close relation therewith was the carrying out of the division of labour of the central stations of the individual states. This principle must be recognised as of the greatest importance for the further development of Marine Meteorology. The repetition of work over definite regions, with reference to the area to be investigated, must be declared as indefensible in the interests of this development."

It was further resolved—"That the convening of a Maritime Meteorological Conference is desirable."

While accepting the above resolutions as a general expression of the principles which should form the basis of an agreement as to future operations in the field of Ocean Meteorology, the Sub-Committee to whom the negotiations preparatory to the assembling of a Conference have been entrusted, consider that it is advisable to enter more minutely into the details, and have accordingly agreed on the following series of questions:—

In the case of a nation which sent any representative to the Brussels Conference in 1853, a circular should be addressed to the chief of the Office for Maritime Meteorology, if such exist, or to the chief of the meteorological organisation of the country, requesting him to state:—

1. To what extent the resolutions adopted at Brussels have been carried out in this country?

2. What have been the grounds for departure from them, if such departure has taken place?

and to send his reply to the Secretary to the Sub-Committee, Mr. Robert H. Scott, 116, Victoria Street, London, S.W., before June 1 next, in order to allow ample time to draw up a report on the replies for consideration at the Conference.

It seems advisable that, as above stated, the action taken at Vienna should be carefully reconsidered under several heads which will now be recapitulated.

I. *Observations.*—In respect of this subject it will be most convenient to take the "Abstract Log" of the Brussels Conference, and to discuss the several subjects of observation therein in the order of sequence of the columns.

Cols.	1 and 6.	Date and position of the observations.—Is it your opinion that a fresh column should be added, headed "Course and Distance by the Log in every Watch of four hours"?
,,	7 and 8.	Currents.
,,	9	Magnetic variation.—Is it desirable to give an additional column for the "Direction of Ship's Head"?
,,	10 and 11.	Wind, direction and force.—Is it possible to employ an anemometer at sea so as to give trustworthy results? Can the use of the Beaufort Scale be made universal?
,,	12 and 13.	Barometer.—To what degree of minuteness is it necessary to observe this instrument?
,,	14 and 15	Thermometer—Dry bulb and wet bulb.—Should these observations be required from all ships?
,,	16.	Forms and direction of clouds.—Is this column sufficient, or should any notice be taken of more than one stratum of clouds?
,,	17.	Proportion of sky clear —Is it not advisable to substitute for this heading "Proportion of sky clouded"?
,,	18	Hours of rain, fog, snow, &c.—Is it desirable to retain this heading, or to substitute for it and No. 23 a column headed—"Weather by Beaufort Notation"?
,,	19.	State of the sea.—Should this be given according to a numerical scale?
,,	20.	Temperature of sea surface.
,,	21.	Specific gravity of sea surface.
,,	22.	Temperature at depths.—Is it desirable to retain these two last columns, or can the observations when taken be inserted in the column for "Remarks"?
,,	23.	Weather. See No. 18.
,,	24.	Remarks.

II. *Instruments.*—What patterns of instruments should be employed for any observations which may require them? Is there a reasonable possibility of introducing the metric and centigrade systems for general use at sea?

III. *Instructions.*—Is it possible to devise a general form of instructions to ensure uniformity in regard of methods of observation and registration?

IV. *Observers.* —What control should be exercised over the observers as to their instruments and registers? Is it desirable that all instruments employed should be the property of the central establishment, and *lent* to the observers?

V. *Co operation of the Royal Navy.*—To what extent can ships of war assist in forwarding the ends of meteorological inquiry?

VI. *Discussion* —Can general suggestions be thrown out as to the most profitable mode of discussion of the observations?

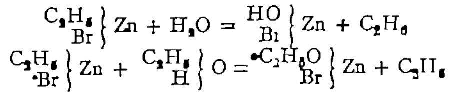
VII. *Subjects of Inquiry.*—To what extent can a division of labour as regards subjects of inquiry be carried out in a spirit of fairness to the collecting and discussing establishments respectively?

VIII. *Sailing Directions.*—In how far are purely practical investigations, such as the preparation of sailing directions, admissible for a scientific institution?

Any gentleman into whose hands this programme may come, and who is himself not likely to attend the Conference, is requested to forward any remarks he may wish to make on any of the subjects mentioned herein to Mr. Scott, at the above address, before July 1, 1874.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for May contains the following papers communicated to the Society:—On the action of bromine on alizarin, by W. H. Perkin. Alizarin heated in a sealed tube with a solution of bromine in carbon disulphide yields monobromalizarin, $C_{14}H_7BrO_4$. This latter substance heated with acetic anhydride gives diacetobromalizarin, $C_{14}H_5Br(C_2H_3O)_2O_4$, and with nitric acid a mixture of phthalic and oxalic acids, while free bromine is given off. Specimens of cotton prints showing the difference in the shade of colour produced by alizarin and bromalizarin when used as dyeing materials accompany the paper.—Note on the action of trichloracetyl chloride upon urea, by Raphael Meldola and Donato Tommasi. The authors have obtained trichloracetyl urea $CO\left\{\begin{matrix}NH(C_2Cl_3O)\\NH_2\end{matrix}\right.$.—Researches on the action of the copper-zinc couple on organic bodies. Part V. On the bromides of the olefines; and Part VI. On ethyl bromide, by Dr. J. H. Gladstone and A. Tribe. The couple acts upon dry ethylene bromide, producing ethylene by double decomposition; in presence of alcohol the decomposition is explosive. The action of the couple is the same either in presence of alcohol or water, and the fact that these substances facilitate the action is explained by the authors by the solvent action of these liquids on the film of zinc bromide formed on the surface of the couple. Propylene and amylene bromides are decomposed in a similar manner, yielding the corresponding olefines. With regard to the action of the couple on ethyl bromide the authors are of opinion that ethylo-bromide of zinc $\left.\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn$ is always formed, and this on further heating produces zinc ethyl and zinc bromide or two semi-molecules of ethyl may decompose with the formation of ethane and ethylene. In presence of water or alcohol ethane is always produced according to the reactions:—



$$\left.\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn + H_2O = \left.\begin{matrix}HO\\Br\end{matrix}\right\}Zn + C_2H_6$$

$$\left.\begin{matrix}C_2H_5\\Br\end{matrix}\right\}Zn + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O = \left.\begin{matrix}C_2H_5O\\Br\end{matrix}\right\}Zn + C_2H_6$$

—The agglomeration of finely-divided metals by hydrogen, by Alfred Tribe. Copper, palladium, and platinum in a finely-divided state agglomerate when hydrogenised. By way of hypothesis the author suggests that the minute particles of the metals are surrounded by layers of liquid hydrogen which coalesce.—The last paper is by Andrew Fuller Hargreaves On the spontaneous combustibility of charcoal. The maximum amount of oxygen is absorbed from the atmosphere within three days after carbonisation, so that from that time charcoal may be used for gunpowder without danger, but up to that period spontaneous combustion is liable to occur. About three-fourths of the journal is devoted to foreign abstracts.

Transactions of the Manchester Geological Society, vol. xiii. Part IV.—The papers in this part are the following:—On coal-cutting machinery, by Mr W. H J. Trace; Additional notes on the millstone grit of the parish of Halifax, by Mr. James Spencer; On Permian and Trias, by Mr. E. W. Binney, F.R S., ; On Pleistocene mammalia found near Castleton, Derbyshire, by Mr. J. Plant, F.G.S.

Proceedings of the Geologists' Association, vol. iii. No. 5.—Besides an account of some of the excursions made by the Association during 1873 the number contains the following papers, abstracts of which have been given in our reports of the Society's proceedings:—On some fossils from the Margate chalk, by J. W. Wetherell, with illustrations; On the valley of the Vézère, Périgord, its limestones, caves, and Prehistoric remains, by Prof. T. Rupert Jones, F.R.S.; On ammonite zones in the Isle of Thanet, by F. A. Bedwell. The last-mentioned occupies a large part of the number, and is illustrated.

Bulletin of the Essex (Salem, U.S.) Institute, vol. iv., 1872. —The principal papers in the *Bulletin* of this very efficient Institute for 1872 are a communication from Mr. S. A. Nelson On the Meteorology of Mount Washington, the main purpose of which is to show the advantages for meteorological purposes mountain-stations offer over those less elevated; and a "Catalogue of the Mammals of Florida, with notes on their Habits, Distribution," &c., by C. J. Maynard.—The *Bulletin* for 1873 contains more papers of scientific interest than that of the previous year.—The first paper is a short one, by Dr. A S. Packard, On the glacial phenomena of north-east America compared with those of Europe.—There is a short but interesting statement by Mr. J. H. Emerton of the results of his observations on worms of the genus *Nais.*—Mr. S. M. Allen contributes a paper On ancient and modern theories of light, heat, and colour.—Mr. H. Herrick contributes a Partial Catalogue, of considerable length, of the birds of Grand Menan, N.B.—Mr. F. W. Putnam has a paper on the various forms of cutting instruments made of stone.—"Notes on the bird-fauna of the Salt Lake Valley and the adjacent portions of the Wahsatch Mountains," is the title of a long paper by Mr. R. Ridgway, who also contributes a paper on the birds of Colorado, and, along with Mr. S. F. Baird, one on some new forms of American birds.—There are also interesting accounts of the numerous and profitable excursions made during the summer months by the Institute.—There is a very minute account of the celebration of the 25th anniversary of the Institute on March 5, 1873. Many well-known scientific men were present, and among others Prof. O. C. Marsh, who paid the high compliment to the Institute that through its influence the botany and zoology of Essex county were better understood than those of any other county in the United States. It was at the hands of the Essex Institute, he said, that he himself acquired his taste for scientific investigation.

Poggendorff's Annalen der Physik und Chemie, No. 3, 1874.—This number commences with a translation of Dr. Draper's recent paper on photography of the diffraction spectrum (which has already appeared in our columns).—The conductivity of flame for galvanic currents is known to be greatly exalted by presence of metallic vapours, and M. Herwig was led to inquire whether a gaseous layer, entirely formed of such vapours, would not show good conductivity even at low temperatures. He experimented with mercury, dense vapours of which can be had several hundred degrees under white heat. The vapour conductivity he finds to resemble that of the voltaic arc, rather than that of a simple metallic conductor. There is a peculiar transition-resistance, which is great in comparison with the hindrances which the current finds within the vapour-layer itself; so that the total resistance is in great measure independent of the extent of the vapour-layer. The transition-resistance is less with increased electromotive force of battery or strength of current. Further, the vaporisation in the positive mercury surface was increased by the current; another point of analogy to the voltaic arc (in which, if the electrodes be mercury and platinum, the mercury is vaporised only when it forms the positive pole); and, using a platinum point and a mercury surface, the resistance of the vapour (like that of the arc) was greater when the mercury surface was positive.—M. Friedrich Müller concludes his investigation on galvanic polarisation and the distribution of the current in electrolytes. He states that, with copper plates in dilute sulphuric acid, and also in a solution of sulphate of copper mixed with sulphuric acid, the polarisation follows a simple law: it is a linear increasing function of the density of current. Another observation of the author is that cupric oxide is reduced to copper by galvanic hydrogen (confirming previous observations that galvanic hydrogen is considerably more active than ordinary hydrogen).—The galvanic conductivity of sulphuric acid and muriatic acid, and its dependence on temperature, is the subject of a communication from M. Grotrian.—In pursuing his researches on the compressibility of elastic fluids M. Regnault did not experiment with pressures lower than one atmosphere. The difficulty of the inquiry has perhaps deterred physicists since. We here find it undertaken, however, by M. Siljestrom, who contributes a paper on the subject; in the first part here given the details of apparatus are fully described, and the numerical results of some sixteen series of experiments tabulated.—M. Schneider communicates a ninth paper on new salts of sulphur, and M. Kessler describes "the simple euthyoptic spectroscope."—Among matter from other journals we note a valuable paper by M. Boltzmann, On experimental determination of the dielectricity constants of insulators.

Astronomische Nachrichten, No. 1,995.—This number contains a large number of observations of position, taken at Leipsig, of some of the minor planets—Comet II. (Tempel), Comet III. (Borelly), Comet IV. (Henry), and Comet VII. (Coggia); also the mean planes of sixty-nine variable stars for the year 1873.—Prof. d'Arrest sends his observations on the position of Coggia's comet, taken during May last.—An astronomical prize is offered by the Academy at Copenhagen for research on the data of the ancients comprised between the time of Ptolemy and the eighteenth century.—The discovery of a new planet is anounced from Toulouse by Mr. Perrotin, May 19, 10 P.M. R.A. 16h. 28m. 30s.; D. 22° 48′.—No. 1,996 contains a discussion of the errors of levels due to the change of direction of attraction caused by the spheroidal figure of the earth and other local causes, and Prof. Spoerer gives the results of his sun-spot and protuberance observations for April and May last.

Abhandlungen der Schlesischen Gesellschaft fur Vaterländische Cultur, 1872–73.—Dr. Gratzer here furnishes a number of social statistics regarding Breslau gathered from the census made in December of that year. From a comparison with Berlin, the population of which (825,389) was then nearly four times that of Breslau, it appears that Breslau is less crowded; there being in it a dwelling-house to every 38·9 of the inhabitants, whereas in Berlin the proportion is 1 to every 56·9. On the whole it appears that, notwithstanding the better proportion of dwellings in Breslau, the health of the two cities is nearly alike, Breslau having counterbalancing disadvantages in bad buildings, sites, drinking and underground water, and soil.—M. Limpricht contributes a report on the watershed between Weide and Bartsche, with a list of the plants found in that region.

Verh. der k.k. zool. bot. Gesellschaft in Wien, 23ter Band, 1873.—This volume, of more than 600 closely-printed pages, is chiefly occupied by papers on entomology and botany. Among the most important are:—*Insecta.*—Contributions to the Orthoptera of the Tyrol: Krauss; Diptera collected in Galicia; Hymenoptera: Kriechbaumer; Microlepidoptera of Leghorn, by J. Mann; Contributions to the nocturnal Lepidoptera of North America, by Prof. Zeller (second part) with figures: more than a hundred new species are described; Contributions to the Phryganidæ, by Dr. Hagen of Cambridge, U.S.; Hungarian Diptera: Kowarz; Eight new German species of Diptera: Beling; New butterflies from Asia Minor; On certain species of Tipula and its allied genera: Beling.—*Crustacea.*—On *Lepidurus lubbockii* and the Phyllopoda.—*Vertebrata.*—A graphic account of the breeding and habits of the Pelican on the Danube. Beside *P. onocrotalus* and *P. crispus*, *P. minor* was also found. On *Comephorus baicalensis*, a fish allied to the genus *Cottus*, with two figures: Dybowski.—*Mollusca*—Contributions to the genus *Aeolidia* and its allies, by Dr. Bergh of Copenhagen.—*Botany.*—Contributions to the flora of Lower Austria, by Von Reuss, jun.; Lichens of the Tyrol, by F. Arnold; Fauna of the Brdygebirg in Bohemia; Fungi of south-east Hungary, by Prof. Hazslinsky; The flora of the state-districts in the south-east of Lower Austria: Woloszczak; Contributions to the flora of Lower Austria, by Hackel. The volume contains a photographic portrait of the late Secretary of the Society, Ritter von Frauenfeld, with his latest contributions to Entomology and a biographical notice, by Von Wattenwyl.

Reale Istituto Lombardo. Rendiconti: t. vii., Fasc. i. e ii.—These parts contain the following papers:—Prof. Serpieri communicates his observations of the meteor shower of August 10, 1873, made at Urbino.—Observations concerning the constitutions and combinations of bodies, a paper on molecular physics, by Dr. Guido Grassi.—On a fact of importance in silkworm culture, by Prof. G. Balsamo Crivelli.—Prof. Cesare Lombroso tabulates the height and weight, cranial measurements and capacities, facial angle, &c., of 832 Italian prisoners, dividing them into homicides, thieves, highwaymen, incendiaries, tricksters, deserters, &c. These prisoners were Sicilian, Sardinian, Calabrian, Neapolitan, Piedmontese, Genoese, and Lombardian. The results are discussed in great detail.—Prof. Antonio Bucellati contributes a paper on political economy, entitled "On the theory of capital."

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 11.—Spectroscopic Notes.—On the Evidence of Variation in Molecular Structure, by J. N. Lockyer, F.R.S.

1. In an accompanying note I have shown that when different degrees of dissociating power are employed the spectral effects are different.

2. In the present note I purpose to give a preliminary account of some researches which have led me to the conclusion that, starting with a mass of elemental matter, such mass of matter is continually broken up as the temperature (including in this term the action of electricity) is raised.

3. The evidence upon which I rely is furnished by the spectroscope in the region of the visible spectrum.

4. To begin by the extreme cases, all solids give us continuous spectra; all vapours produced by high tension spark give us line spectra.

5. Now the continuous spectrum may be, and as a matter of fact is, observed in the case of chemical compounds, whereas all compounds known as such are resolved by the high tension spark into their constituent elements. We have a right, therefore, to assume that an element in the solid state is a more complex mass than the element in a state of vapour, as its spectrum is the same as that of a mass which is known to be more complex.

6. The spectroscope supplies us with intermediate stages between these extremes.

(*a*) The spectra vary as we pass from the induced current with jar, to the spark without the jar, to the voltaic arc, or to the highest temperature produced by combustion. The change is always in the same direction; and here again the spectrum we obtain from elements in a state of vapour, a spectrum characterised by spaces and bands, is similar to that we obtain from vapours of which the compound nature is unquestioned.

(*β*) At high temperatures the vapours of some elements (which give us neither line nor channelled-space spectra at those temperatures, although we undoubtedly get line spectra when electricity is employed, as stated in No. 4), give us a continuous spectrum at the more refrangible end, the less refrangible end being unaffected.

(*γ*) At ordinary temperatures, in some cases, as in selenium, the more refrangible end is absorbed; in others the continuous spectrum in the blue is accompanied by a continuous spectrum in the red. On the application of heat the spectrum in the red disappears, that in the blue remains; and further, as Faraday has shown in his researches on gold-leaf, the masses which absorb in the blue may be isolated from those which absorb in the red. It is well known that many substances known to be compounds in solutions, give us absorption in the blue or blue and red, and also that the addition of a substance known to be compound (such as water) to substances known to be compound which absorb the blue, superadds an absorption in the red.

7. In those cases which do not conform to what has been stated the limited range of the visible spectrum must be borne in mind. Thus I have little doubt that the simple gases at the ordinary conditions of temperature and pressure have an absorption in the ultra-violet; that highly compound vapours are often colourless because their absorption is beyond the red, with or without an absorption in the ultra-violet. Glass is a good case in point; others will certainly suggest themselves as opposed to the opacity of the metals.

8. If we assume in accordance with what has been stated that the various spectra to which I have referred are really due to different molecular aggregations, we shall have the following series, going from the more simple to the more complex.

First stage of complexity of molecule.	Line spectrum.
Second stage	Channelled-space spectrum.
Third stage	Continuous absorption at the blue end, not reaching to the less refrangible end. (This absorption may break up into channelled spaces.)
Fourth stage	Continuous absorption at the red end, not reaching to the more refrangible end. (This absorption may break up into channelled spaces.)
Fifth stage	Unique continuous absorption.

9. I shall content myself in the present note by giving one or two instances of the passage of spectra from one stage to another, beginning at the fifth stage.

From 5 to 4

1. The absorption of the vapours of K in the red-hot tube, described in another note, is at first continuous. As the action of the heat is continued, this continuous spectrum breaks in the middle, one part of it retreats to the blue, the other to the red.

From 4 to 3

1. Faraday's researches on gold leaf best illustrate this, but I hold that my explanation of them by masses of two degrees of complexity only, is sufficient without his conclusion ("Researches in Chemistry," p. 417), that they exist "of intermediate sizes or proportions."

From 3 to 2

1. Sulphur vapour first gives a continuous spectrum, at the blue end, on heating this breaks up into a channelled-space spectrum.

2. The new spectra of K and Na (more particularly referred to in the following note) make their appearance after the continuous absorption in the blue, and red vanishes.

From 2 to 1

1. In many metalloids the spectra without the jar are channelled; on throwing the jar into the circuit the line spectrum is produced, while the cooler exterior vapour gives a channelled absorption-spectrum.

2. The new spectra of K and Na change into the line-spectrum (with thick lines which thin subsequently) as the heat is continued.

Spectroscopic Notes.—On the Molecular Structure of Vapours in connection with their Densities, by J. N. Lockyer, F.R.S.

1. I have recently attempted to bring the spectroscope to bear upon the question whether vapours of elements below the highest temperatures are truly homogeneous, and whether the vapours of different chemical elements at any one temperature are all in the same molecular condition. In the present note I beg to lay before the Royal Society the preliminary results of my researches.

2. We start with the following facts:—

I. All elements driven into vapour by the induced current give line-spectra.

II. Most elements driven into vapour by the voltaic arc give us the same.

III. Many metalloids when greatly heated, some at ordinary temperatures, give us channelled-space spectra.

IV. Elements in the solid state give us continuous spectra.

3. If we grant that these spectra represent to us the vibrations of different molecular aggregations, and this question is discussed in another the previous (note) spectroscopic observations should give us facts of some importance to the inquiry.

4. To take the lowest ground. If, in the absence of all knowledge on the subject, it could be shown that all vapours at all stages of temperature had spectra absolutely similar in character, then it would be more likely that all vapours were truly homogeneous and similar among themselves as regards molecular condition than if the spectra varied in character, not only from element to element, but from one temperature to another in the vapour of the same element.

5. At the temperature of the sun's reversing layer the spectra of all the elements known to exist in that layer are apparently similar in character, that is they are all line spectra; hence it is most probable that the vapours there are truly homogeneous and that they all exist in the same molecular condition, than if the spectrum were a mixed one.

6. The fact that the order of vapour densities in the sun's atmosphere which we can in a measure determine by spectroscopic observations does not agree with the order of the modern atomic weights of the elements, but more closely agrees with the older atomic weights, led me to take up the present research. Thus I may mention that my early observations of the welling up of Mg vapour all round the sun *above the Na vapour*, have lately been frequently substantiated by the Italian observers. So that it is beyond all question, I think, that *at the sun* the vapour density of Mg is less than that of Na.

7. The vapour densities of the following elements have been experimentally determined:—

H	1	S	32 (at 1,000°)
K	39	I	127
As	150	Hg	100
Br	80	N	14
Cd	56	O	16
Cl	35·5	P	62

8. To pursue this inquiry the following arrangements have been adopted:—

The first experiments were made last December upon Zn in a glass tube closed at each end with glass plates; and I have to express my obligations to Dr. Russell for allowing them to be conducted in his laboratory, and for much assistance and counsel concerning them.

A stream of dry H was allowed to pass. The tube was heated in a Hofmann's gas furnace, pieces of the metal to be studied having previously been introduced. It was found that the glass tube melted; it was therefore replaced by an iron one. The inconvenience of this plan, however, owing to the necessity for introducing the metal into the end of the hot tube when the first charge had volatilised, and moreover the insufficiency of the heat obtainable from the gas furnace, soon obliged me to replace both tube and furnace by others, which have now been in use for many weeks, and which still continue to work most satisfactorily

The iron tube is 4 ft. in length, and is provided with a central enlargement, suggested to me by Mr. Dewar, forming a T-piece by the screwing in of a side tube, the end of which is left projecting from the door in the roof of the furnace. Caps are screwed on at each end of the main tube; these caps are closed by a glass plate at one end, and have each a small side tube for the purpose of passing hydrogen or other gases through the hot tube. The furnace is supplied with coke or charcoal, an electric lamp connected with thirty Grove's cells is placed at one end of the tube and a one-prism spectroscope at the other. The temperatures reached by this furnace may be conveniently divided into four stages:—

I. When the continuous spectrum of the tube extends to the sodium line D, this line not being visible.

II. When the continuous spectrum extends a little beyond D, this line being visible as a bright line.

III. When the spectrum extends into the green, D being very bright.

IV. When the spectrum extends beyond the green and D becomes invisible as a line, and the sides of the furnace are at a red heat.

I may add (1) that I have only within the last few days been able to employ the third and fourth stages of heat, as the furnace was previously without a chimney, and the necessary draught could not be obtained; and (2) that I was informed a little time ago by Prof. Roscoe that with a white-hot tube he had observed new spectra in the case of Na and K. These spectra which I now constantly see, when these temperatures are reached, I shall call the "new spectra."

9. The results of the experiments, so far as the visible spectrum is concerned, between the stages indicated, may be stated as follows:—

H No absorption.
N " "
K I have observed either separately or together.
  (α) The line absorption line near D.
  (β) Continuous absorption throughout the whole spectrum.
  (γ) Continuous absorption in red and blue at the same time, the light being transmitted in the centre of the spectrum (as by gold-leaf).
  (δ) Continuous absorption clinging on one side or other of the line. (This phenomenon which, so far as I know, is quite new, will be described in another note.)
  (ε) The new spectrum.
Na I have observed either separately or together.
  (α) D absorbed.
  (β) Continuous absorption throughout the whole spectrum.
  (γ) Continuous absorption clinging on one side or the other of D.
  (δ) The new spectrum.
Zn Continuous absorption in the blue. (An unknown line sometimes appears in the green, but certainly no line of Zn.)
Cd Continuous absorption in the blue.
Sb New spectrum with channelled spaces and absorption in the blue.
P The same. (This, however, in consequence of the extreme delicacy of the spectrum requires confirmation.)
S Channelled-space spectrum (previously observed by Salet).
As Probable channelled-space spectrum. (Observations to be repeated.)
Bi No absorption.
I Channelled spectrum in the green and intense bank of general absorption in the violet, where at the ordinary temperature the vapour transmits light.
Hg No absorption.

10. These results may be tabulated as follows:—

	V.d.	Modern atomic weight.	
H	1	1	No visible absorption.
K	39	39	Line absorption.
As	150	75	Probable channelled-space absorption.
Cd	56	112	Continuous absorption in the blue.
I	127	127	Channelled-space absorption + band of absorption in violet.
Hg	100	200	No absorption.
N	14	14	" "
O	16	16	Not observed.
P	62	31	Channelled-space spectrum probable.
Na	(?)	23	Line absorption.
Zn	(?)	65	Continuous absorption in the violet.
Sb	(?)	122	Channelled-space spectrum and absorp- in the blue.
S	32	32	Channelled-space spectrum.
Bi	(?)	208	No absorption.

11. It will be seen from the foregoing statement that if similar spectra be taken as indicating similar molecular conditions, then the vapours, the densities of which have been determined, have not been in the same molecular condition among themselves. Thus the vapours of K, S, and Cd at the fourth stage of heat gave us line, channelled space, and continuous absorption in the blue, respectively. This is also evidence that each vapour is non-homogeneous for a considerable interval of time, the interval being increased as the temperature is reduced.

On the alleged Expansion in Volume of various substances in passing by Refrigeration from the state of Liquid Fusion to that of Solidification, by Robert Mallet, F.R.S.

Since the time of Reaumur it has been stated with very various degrees of evidence, that certain metals expand in volume at or near their points of consolidation from fusion. Bismuth, cast-iron, antimony, silver, copper, and gold are amongst the number, and to these have recently been added certain iron-furnace slags. Considerable physical interest attaches to this subject from the analogy of the alleged facts to the well-known one that water expands between 30° F. and 32°, at which it becomes ice; and a more extended interest has been given to it quite recently by Messrs. Nasmyth and Carpenter having made the supposed facts, more especially those relative to cast-iron and to slags, the foundation of their peculiar theory of lunar volcanic action as developed in their work "The Moon as a Planet, as a World, and a Satellite" (4to, London, 1874). There is considerable ground for believing that bismuth does expand in volume at or near consolidation; but with respect to all the other substances supposed to do likewise, it is the object of this paper to show that the evidence is insufficient, and that with respect to cast-iron and to the basic silicates constituting iron slags, the allegation of their expansion in volume, and therefore their greater density when molten than when solid, is wholly erroneous. The determination of the specific gravity in the liquid state of a body having so high a fusing temperature as cast-iron is attended with many difficulties. By an indirect method, however, and operating upon a sufficiently large scale, the author has been enabled to make the determination with considerable accuracy. A conical vessel of wrought iron of about 2 ft. in depth and 1·5 ft. diameter of base, and with an open neck of 6 in. in diameter, being formed, was weighed accurately empty, and also when filled with water level to the brim; the weight of its contents in water, reduced to the specific gravity of distilled water at 60° F. was thus obtained. The vessel, being dried, was now filled to the brim with molten grey cast-iron, additions of molten metal being made to maintain the vessel full until it had attained its maximum temperature (yellow heat in daylight) and maximum capacity. The vessel and its contents of cast-iron when cold were weighed again, and thus the weight of the cast-iron obtained. The capacity of the vessel when at a maximum was calculated by applying to its dimensions at 60° the coefficient of linear dilatation, as given by Laplace and others, to its range of increased temperature; and the weight of distilled water held by the vessel thus expanded was calculated from the weight of its contents when the vessel and water were at 60° F. after applying some small corrections.

We have now the elements necessary for determining the specific gravity of the cast-iron which filled the vessel when in the molten state, having the absolute weights of equal volumes of distilled water at 60° and of molten iron. The mean specific gravity of the cast-iron which filled the vessel was then determined by the usual methods. The final result is that, whereas the specific gravity of the cast-iron when cold was 7·170 it was only 6·650 when in the molten condition; cast-iron, therefore, is less dense in the molten than in the solid state. Nor does it expand in volume at the instant of consolidation, as was conclusively proved by another experiment. Two similar 10-inch spherical shells 1·5 in. in thickness, were heated to nearly the same high temperature in an oven, one being permitted to cool empty as a measure of any permanent dilatation which both might sustain by mere heating and cooling again, a fact well known to occur. The other shell, when at a bright red heat, was filled with molten cast-iron and permitted to cool, its dimensions being taken by accurate instruments at intervals of thirty minutes, until it had returned to the temperature of the atmosphere (53° F.), when, after applying various corrections, rendered necessary by the somewhat complicated conditions of a spherical mass of cast-iron losing heat from its exterior, it was found that the dimensions of the shell whose interior surface was in perfect contact with that of the solid ball which filled it were, within the limit of experimental error, those of the empty shell when that also was cold (53° F.), the proof being conclusive that no expansion in volume of the contents of the shell had taken place, which was further corroborated by the fact that the central portion was found much less dense than the exterior, whereas if the cast-iron expanded in consolidating the central portions must be more dense than the exterior.

It is a fact, notwithstanding what precedes and well known to iron-founders, that certain pieces of cold cast-iron do float on molten cast-iron of the same quality, though they cannot do so through their buoyancy, as various sorts of cast-iron vary in specific gravity at 60° F., from nearly 7·700 down to 6·300, and vary also in dilatability; that thus some cast-irons may float or sink in molten cast-iron of different qualities from themselves through buoyancy or negative buoyancy alone; but where the cold cast-iron floats upon molten cast-iron of less specific gravity than itself, the author shows that some other force, the nature of which yet remains to be investigated, keeps it floating; this the author has provisionally called the repellent force, and has shown that its amount is, *cæteris paribus*, dependent upon the relation that subsists between the volume and "effective" surface of the floating piece. By "effective" surface is meant all such part of the immersed solid as is in a horizontal plane, or can be reduced to one. The repellent force has also relations to the difference in temperature between the solid and the molten metal on which it floats.

The author then extends his experiments to lead, a metal known to contract greatly in solidifying, and with respect to which there is no suggestion that it expands at the moment of consolidation. He finds that pieces of lead having a specific gravity of 11·361 and being at 70° F. float or sink upon molten lead of the same quality, whose calculated specific gravity was 11·07, according to the relation that subsisted between the volume and the "effective" surface of the solid piece, thin pieces with large surface always floating, and *vice versa*. An explanation is offered of the true cause of the ascending and descending currents observed in very large "ladles" of liquid cast-iron, as stated by Messrs. Nasmyth and Carpenter. The facts are shown to be in accordance with those above mentioned, and when rightly interpreted to be at variance with the views of these authors.

Lastly, the author proceeds to examine the statements made by those authors, as to the floating of lumps of solidified iron-furnace slag upon the same when in a molten state; he examines the conditions of the alleged facts, and refers to his own experiments upon the total contraction of such slags, made at Barrow Ironworks, and a full account of which he has given in his paper On the true nature and origin of volcanic heat and energy, printed in Phil. Trans. 1873, as conclusively proving that such slags are not denser in the molten than in the solid state, and that the floating referred to is due to other causes. The author returns thanks to several persons for facilities liberally afforded him in making these experiments.

Chemical Society, June 18.—Prof. Frankland, F.R.S., vice-president, in the chair.—The following papers were read:—On the action of chlorine, bromine, &c., on isodinapthyl, by W. Smith.—Dr. Armstrong then read four communications from the laboratory of the London Institution, No. XIII. On coal-tar cresol and some derivatives of paracresol, by H. E. Armstrong, and C. L. Field; No. XIV. On the action of the chlorides of the acids of the sulphur series on organic compounds, by H. E. Armstrong and W. H. Pike; No. XV. On chloro, bromo, and iodo-nitrophenolparasulphonic acids, by H. E. Armstrong and F. D. Brown; and No. XVI. Note on the decomposition of dichloronitrophenol by heat, by H. E. Armstrong and F. D. Brown.—The sixth paper was by Mr. F. Neison, On the products of the decomposition of castor oil, No. III. On decomposition by excess of alkaline hydrate, in which he has succeeded in elucidating the conflicting statements of different chemists on this subject.—On hydrogen persulphide, by Dr. W. Ramsay.—Suberone, by Dr. C. Schorlemmer and Mr. R. S. Dale.—On the action of nitrosyl chloride on organic bodies. Part I.—On phenol, by Dr. W. A. Tilden, —An apparatus for determining the moisture and carbonic anhydride in the atmosphere; A method for determining ozone in the presence of chlorine and nitric oxide; and On the constitution of urea, by Dr. D. Tommasi.—On the restitution of burnt steel, by Mr. S. L. Davies.—On the action of earth on organic nitrogen, by Mr. E. C. Stanford.—Aniline and its homologues in coal-tar oils, by Mr. W. Smith.

Zoological Society, June 16.—Dr. A. Gunther, vice-president, in the chair.—An extract was read from a letter received from Dr. A. B. Meyer, concerning two birds (*Rectes bennetti* and *Campephaga aurulenta*) lately described in the Society's Proceedings by Mr. Sclater.—A letter was read from Mr. William Summerhayes, relating to certain species of Curassows found in Venezuela.—Dr. J. Murie read a paper on the nature of the sacs vomited by the Hornbills, which he stated, in confirmation of Prof. Flower's account of these objects, to consist of the epithelial lining of the stomach.—Mr. W. Saville Kent, F.L.S., communicated a second paper upon the gigantic cephalopods recently encountered off Newfoundland. From further information received, Mr. Saville Kent apprehended that it would be necessary to refer the two individuals preserved in St. John's Museum to the genus *Ommatostrephes*, thus avoiding the institution of a new genus for their reception, as proposed in his former paper.—Mr. A. H. Garrod read a paper on the "showing off" of the Australian Bustard (*Eupodotis australis*) and pointed out the peculiar structures by which this "showing off" was accomplished.—A communication was read from Dr. F. Stoliczka, containing a description of the *Ovis poli* of Blyth, of which he had lately obtained specimens in Yarkand.—Mr. R. B. Sharpe read a paper on a new genus and species of Passerine birds from the West Indies, which he proposed to name *Phænicomanes iora*.—A communication was read from the Rev. O. P. Cambridge, containing descriptions of some new species of Spiders of the genus *Erigone* from North America.—Dr. Gunther read a paper describing some new species of reptiles from the Camaroon Mountains, West Africa. Amongst these were two new species of Chameleon, and a new snake of the family of Lycodontidæ, proposed to be called *Bothrolycus ater*. One of these Chameleons was referred to a new subgenus (*Rhampholeon*), being remarkable for its abbreviated tail and the development of a denticle at the inner base of each claw.—Mr. Sclater read a paper containing a description of three new species of the genus *Synallaxis* from M. Jelski's collections in Central Peru, which he proposed to call *S. pudibunda*, *S. graminicola*, and *S. virgata*.—Messrs. H. P. Blackmore and E. R. Alston communicated a joint paper on the Arvicolidæ which have hitherto been found in a fossil state.—Prof. Newton read an account of a living Dodo shipped for England in the year 1628, extracted from letters in the possession of Dr. J. B. Wilmot, of Tunbridge Wells.—Mr. J. E. Harting read a paper on the common Lapwing of Chili, which he proposed to separate from *Vanellus cayanensis*, under the name *V. occidentalis*.—A second paper read by Mr. Harting contained an account of the eggs of some new or little-known Limicolæ.—A communication was read from Mr. R. Swinhoe containing an account of a new Cervine form discovered in the mountains near Ningpo, China, by Mr. A. Michie, and proposed to be called *Lophotragus michianus*.—Dr. J. Murie read a paper on the structure of the skeleton of *Fregilupus varius*, based on a specimen in the Museum of Cambridge.

Meteorological Society, June 17.—Dr. R. J. Mann, president, in the chair.—On the connection between colliery explosions and weather in the year 1872, by Robert H. Scott, F.R.S., and W. Galloway, Inspector of Mines. The paper is in continuation of those by the same authors read before the Royal Society in 1872, and before the Meteorological Society in 1873, which contained the results for the four preceding years. The number of fatal explosions which occurred during the year was 70, causing the loss of 163 lives. Three of these killed each of them more than ten men, being the same as the average *number* of serious explosions for the last twenty years. The number of non-fatal explosions was 224. A comparison of the dates of all recorded explosions with the curves of the barometer and thermometer kept at Stonyhurst for the Meteorological Office, as shown on a diagram, lead to the following results:—58 per cent. of the explosions are due to changes of pressure, 17 per cent. to great heat of the weather, while 25 per cent. are not attributed by the authors to meteorological agencies. These proportions are nearly the same as those which have come out from the discussions of similar facts for previous years. The paper next deals with an objection which has been raised to the reasoning in its predecessors, viz. that it is not fair to take the meteorological records for Stonyhurst as a test of the atmospherical phenomena in a coalfield situated at some distance from the observatory. The authors show, by taking an instance of a barometrical depression, whose centre passed over Stonyhurst, and which was accompanied by an explosion in South Wales, that such an objection as that cited could never have originated with anyone accustomed to deal with daily weather charts. The next question discussed was the alleged greater prevalence of explosions with certain winds; and it was shown by the most reliable data for our climate that the ordinary changes of pressure and temperature in the windrose were hardly sufficient to account for the explosions which are found to accompany the *sudden* changes of weather. The paper proceeds with a discussion of a diagram exhibiting the continuous curve of barometrical pressure from Glasgow Observatory for the last nine months of 1873, and a curve showing the prevalence of fire-damp in the mines of the West of Scotland district for the period. These latter returns have been furnished by Mr. Galloway from the entries in the books ordered to be kept at each mine by the Coal Mine Regulation Act, 1872. The books of thirty-five mines about Glasgow have been used for the comparison. The two curves show a very remarkable accordance in their course, though that of fire-damp exhibits some striking irregularities, owing probably to the fact of the men having been slow to learn the new duties required of them by the Act. It may be expected that these irregularities will disappear in future years. The result places it beyond the possibility of a doubt that the escape of fire-damp is related mainly to the conditions of atmospherical pressure, and that a careful watch over the barometer is, above all, necessary in each colliery, though one such record would suffice for several adjacent mines. The paper gives some instances of explosions which might all have been prevented by proper ventilation and by the use of safety-lamps, and states how pressing the need is that safety-lamps only should be used in all places where fire-damp may accumulate, whenever the atmosphere is in a disturbed condition, as shown by the record of the barometer and thermometer. The authors conclude by stating their conviction that it is not too much to ask those charged with the responsibility of the safety of miners' lives to learn the first principles of the laws of diffusion and intermixture of gases, and to familiarise themselves with the use of the barometer and thermometer, so as to know when it behoves them to take extra precautions in the management of their mines. —Solar radiation, 1869–74, by Rev. F. W. Stow.—The diurnal inequalities of the barometer and thermometer, as illustrated by the synchronous observations made during May 1872 at the summit and base of Mount Washington, New Hampshire, at the respective heights of 2,615 ft. and 6,283 ft. above the sea-level, by W. W. Rundell. The hourly mean differences of pressure and temperature at these stations and at Portland, Maine, the nearest U.S. station to Mount Washington, are discussed and their most probable coefficients are determined, also the times at which their maxima and minima occur.—On the diurnal variation of the barometer at Zi-Ka-Wei, and mean atmospheric pressure and temperature at Shanghai, by Rev. A. M. Colombel. —Weather report for 1873 at Woosung, China, by C. D. Braysher.—Notes regarding a remarkable hailstorm at Pietermaritzburg, Natal, on April 17, 1874, by Rev. J. D. La Touche.

Royal Astronomical Society, June 12.—Prof. Adams, president, in the chair.—A paper by Mr. Stone, the Government astronomer at the Cape of Good Hope, was read, describing his observations of the eclipse of April 16 made near Klipfontein, in South Africa, of which an account has been given in NATURE (vol. x. p. 59).—Mr. Bidder described a micrometer which he had contrived for measuring the position of very faint stars. Ghosts of the wires, which can be rendered dimmer or brighter at the discretion of the observer, are projected into the field of view by means of reflecting prisms; and diaphragms can be used, cutting out the light of the wires from any portion of the field.—M. d'Abbadie was called upon to give some account of the French preparations for the transit of Venus. The French Government will occupy five stations, and will make use of the Daguerreotype in preference to the collodion process. Their photographs will be taken in the principal focus of their instruments, and the image of the sun will thus be only about 36 millimetres in diameter. The trial photographs are so sharp that they hope to be able to make use of a magnifying power of 250 in measuring the photographs for the purposes of reduction.—The President announced to the Society that a petition was about to be presented to the Dean of Westminster, praying him to admit of the erection of some memorial to Jeremiah Horrox in Westminster Abbey.—It was announced that the next meeting of the Society would be held in their new room in Burlington House.

PARIS

Academy of Sciences, June 15.—M. Bertrand in the chair.—The following papers were read:—Solar theories; reply to some recent criticisms, by M. Faye. The author meets objections raised by MM. Ledieu, Duponchel, and P. Secchi, in former numbers of the *Comptes Rendus*.—On the heat evolved by chemical reactions in the different states of bodies, by M. Berthelot. The author considered the heat developed in the gaseous, liquid, and solid states.—Observations on the communication relating to Phylloxera made by M. Lichtenstein during the *séance* of June 8.—A note by M. Blanchard, in which the author highly eulogises the experiments of Lichtenstein.—Researches on the electrolysis of the alkaline carbonates and bicarbonates, by MM. P. A. Favre and F. Roche. This is a thermo-chemical research undertaken with a view of throwing light on the constitution of these bodies.—On the phenomena of static induction produced by means of Rhumkorff's coil; a note by M. E. Bichat. The author finds that static electricity, as from the Holtz machine, when passed through the secondary wire gives rise in the primary wire to the development of a current possessing all the properties of the voltaic current, and like this current appearing to have only one direction.—M. J. M. Gaugain presented a note on magnetism.—On some properties of the systems of curves ($\mu = 1, \nu = 1$), by M. Fouret.—Generalisation of a theorem communicated at the *séance* of June 1, by M. H. Durrande.—On oxyfluoboric acid, by M. A. Basarow. This acid is stated to be produced when boric fluoride is passed into water, and the assigned formula is $BO_2H, 3HF$. The present research tends to prove that no such body exists, the composition formerly determined by analysis being a result of chance.—On the absorption of ammonia from the air by vegetables, by M. T. Schloesing. The author has been growing two tobacco plants under precisely the same conditions, except that one plant was freely supplied with ammonia, while the other was excluded from this gas. Analyses prove that the plant supplied with ammonia is much richer in nitrogeneous compounds than the other.—Research on the oxygen dissolved in the water of artesian wells, by M. A. Gérardin. The author concludes that oxygen is never found in subterranean waters if these are kept out of contact with the air. —On a case of lead-poisoning, by MM. G. Bergeron, and L. l'Hote.—On creatine, by M. R. Engel. The author has studied the reactions of this substance.—Anaesthesia by intravenous injection of chloral after the method of Prof. Oré; removal of a cancer from the rectum, by MM. Denoffe and Van Wetter.—On the geology of the regions comprised between Tangiers, El-Araich et Meknès (Morocco), by M. Bleicher. The author has recognised the following formations—recent, tertiary, cretaceous, and jurassic.—On the character of the littoral zone in the English Channel, the ocean, and the Mediterranean, by M. P. Fischer.

CONTENTS

PAGE
THE NEW PHYSICAL LABORATORY OF THE UNIVERSITY OF CAMBRIDGE (*With Illustrations*) 139
THE "CHALLENGER" IN THE SOUTH ATLANTIC 142
COLONIAL GEOLOGICAL SURVEYS. I. CANADA. By Prof. A. GEIKIE, F.R.S. 144
OUR BOOK SHELF 146
LETTERS TO THE EDITOR:—
  Proposed Issue of Daily Weather Charts of Europe and the North Atlantic.—R. H. SCOTT, F.R.S. 146
  The Degeneracy of Man.—E. B. TYLOR, F.R.S. 146
  Flight of Birds.—Prof. F. GUTHRIE 147
  An Optical Delusion 147
  Longevity of the Carp.—Rev. R. R. SUFFIELD 147
LE GENTIL'S OBSERVATION OF THE TRANSIT OF VENUS (*With Illustration*) 148
ON THE TEMPORARY FADING OF SOME LEAVES WHEN EXPOSED TO THE SUN. By H. C. SORBY, F.R.S. 149
THE COMET.—J. R. HIND, F.R.S.; J. N. LOCKYER, F.R.S. 149
NOTES 150
CONFERENCE FOR MARITIME METEOROLOGY. By R. H. SCOTT, F.R.S. 152
SCIENTIFIC SERIALS 153
SOCIETIES AND ACADEMIES 154

THURSDAY, JULY 2, 1874

ON OSTEOLOGICAL MONOGRAPH-WRITING

IN biological Societies, and in others which have any biological interests, there is a question which is daily becoming more and more prominent; one that if not fully investigated shortly will lead to results which are far from advantageous to the science itself, and will throw discredit on its votaries; whilst, if some decided opinion is expressed in such a manner that no doubt can be entertained as to its true meaning, much hard work and unnecessary disappointment may be easily saved.

Some half century or so ago, when zoology was just commencing a new lease of life, as it may be termed, the opportunities afforded to those who were studying the anatomy and physiology of the animal kingdom were comparatively few. Museums were scarce; most of those existing being very incomplete in an educational point of view, and it was almost impossible to procure specimens of any desired species by means of a pecuniary offer. The case is now, however, extremely different. Museums are numerous, and are daily becoming more so. The facilities for locomotion make it easy for anyone anxious to see what cannot be obtained nearer, to visit the British Museum or that of the Royal College of Surgeons; there are dealers who are able to offer typical specimens at a moderate price, and to obtain the rarer forms if necessary. Such being the case it must be evident that a certain change ought to have come over zoological literature, in order that it should progress with the science itself. What was then indispensable is now no longer required, and that which was then unknown takes its place. Nevertheless there are a few comparative anatomists who do not seem to realise the change which has so gradually and so markedly occurred. They think and write with the ideas of fifty years ago, and, what is more, expect us to appreciate their productions as if they were not the least *de trop*.

Formerly, no doubt, it was extremely valuable to have descriptions given in print of the detailed anatomy of particular species. Of their osteology this was especially the case. These descriptions drew attention to previously scarcely recognised characters, and, what was perhaps still more important, did much to fix the nomenclature of the skeleton generally; because, though this had been previously accomplished as far as human anatomy is concerned, there are many reasons, known to all practical students, which make the names adopted in anthropotomy unsatisfactory and incomplete when they have to be applied to the lower vertebrata.

The case is now very different. Skeletons of almost all known animals being contained in museums, and those of common species being abundant, any student prosecuting his investigations in the spirit which insures successful results, will find no difficulty in obtaining opportunities of handling and comparing the bones themselves, and will have but little or no need to refer to plates or descriptions, which are never so satisfactory as the specimens themselves, and are often as difficult to obtain as they are expensive to purchase.

It therefore becomes a question, and a not unimportant one either, as to whether it is to the best interests of our learned Societies to expend their funds in encouraging the further publication of long and exhaustive descriptions of the osteology of common types, and the execution of a large number of elaborate drawings of bones, whose intrinsic worth is considerably less than the cost of their putting on wood or stone. In several instances within the last two or three years, lengthy papers, without doubt the result of much time and attention, have been presented to different Societies, evidently with a full idea on the part of the authors that their monographs will be published, unopposed, in the form in which they send them in; and yet these many pages are found to contain nothing more than the monotonous and unsuggestive descriptions of the bones, one by one, and surface by surface, profusely illustrated, of animals as common as some of the best-known Marsupial mammals or Struthious birds.

A full account of the myology, neurology, or visceral anatomy of almost any animal has a value which no one would wish to depreciate in the least, because these parts are difficult to preserve, and it requires a special training, together with considerable experience in one direction, before such investigations can be undertaken, as they are but too infrequently. But as bones are so easily preserved in a state which cannot shock the most delicate hands or the most sensitive nose, there is no excuse for any student not practically knowing the most important peculiarities of any skeleton, nor for his not prosecuting his investigations to any degree of minuteness when occasion requires.

It has been remarked that these fully illustrated monographs are of especial value in palæontological investigations; that the study of the Pleistocene remains of Australia, for instance, can be conducted on the spot with greater facility when comparisons can be made with existing forms. But, we may ask, where can it be easier, than in Australia itself, to obtain the skeletons of now living Marsupials? and we all know how much better it is to have the bones themselves than drawings of them, however well executed. Further, it has been said that after a certain time it is impossible for any author, however able, to continue to develop generalisations and theories from any number of fresh facts; and such being the case, can those who really like their subject do better than devote themselves to the careful description, uncomplicated with any attempt at inductive reasoning, of what they have the opportunity of observing? We think they can, for we see no reason why the inferior productions of an able man should, on account of his previous reputation, be allowed to be placed on a level with the better work of others, and above those productions of the same quality, the attempts of less known authors.

The fact, however, is that the time is passed for the publication as simple statements of the commonplace facts of osteology; the subject is more than overloaded with them already. What is now wanted is the application to them of some methods by which, like the doctrine of evolution, or the vertebrate theory of the skull, those at present on hand may be turned to better account in determining the true affinities of different animals, or the means by which the present state of things has been arrived at. The comparison of simple fact-accumulation to the introduction of fresh methods of research, or lines of thought, is so insuperably in favour of the latter, that the former has quite descended below the level of that quality of work which needs the distinguishing encouragement afforded by the publication of the results obtained in the "Transactions" of any learned Society.

PICKERING'S "PHYSICAL MANIPULATION"

Elements of Physical Manipulation. By Edward C. Pickering, Thayer Professor of Physics in the Massachusetts Institute of Technology. Part I. (London: Macmillan & Co., 1874.)

To write a satisfactory text-book for students in physical laboratories is a task beset with difficulties; and although Prof. Pickering has had the advantage of no small experience and judgment in the composition of the work the title of which is given above, we do not think that he has entirely overcome them.

There can be little doubt that oral teaching is that which is best suited to students who are beginning experimental work of any sort, and that as much may often be learnt in five minutes by seeing another perform an experiment as would be acquired in as many hours with the aid of a book alone to explain the construction and use of the apparatus; and Prof. Pickering is therefore right in aiming at supplementing rather than superseding the efforts of an instructor.

The work is divided into sections, each of which relates to one or more experiments, and comprises two parts, the first of which, entitled "Apparatus," gives a description of the instrument required, and is designed to aid the instructor in preparing the laboratory for the class, while the second, headed "Experiment," explains in detail to the student what he is to do.

The subjects treated of in the first volume, the only one at present published, are Mechanics, Sound, and Light, an arrangement that does not agree with the order in which they would probably be studied in the laboratory, as the elementary parts of heat ought certainly to be taken with mechanics; but the plan adopted has the advantage that heat and electricity, the subjects in which tables are most required for reference, will be placed together in the second volume, in which also, we presume, sets of tables will be included among the "matters of general interest to the physicist" that are promised in the preface.

Apart, however, from any detailed criticism, we must notice the important preliminary question, how far a work of this sort is likely to fulfil the object with which it is written, of enabling an instructor to superintend a larger class than he could otherwise attend to at once? The members of the class, according to the method of instruction pursued in the Massachusett's Institute, and described in the preface, are not informed precisely what experiments will be allotted to them until they enter the laboratory, and as such is the plan probably generally adopted where the number of pupils is large, it is absolutely necessary for the instructor to have at hand, either in a text-book or in manuscript, short papers on the theory of the different experiments. We do not, however, feel sure that the descriptions of apparatus and methods of performing experiments will prove so valuable as might at first sight appear probable. The instruments required for physical work are often so costly as to make constant supervision necessary over those who are not accustomed to them, and their construction is so various, at all events in minor particulars, that directions for their use which might be all that could be desired in one laboratory might be misleading in another. Another difficulty arises in describing experimental proofs of the simpler laws of Mechanics and Physics which do not require elaborate apparatus for their exhibition, as a choice has often to be made between several different methods, an account of all of which would make the text-book unwieldy in bulk, while the omission of any is apt to make it less useful in laboratories other than that for which it was originally intended. The selection of experiments of this sort must in great measure depend upon the time the pupil is able to devote to the study of physics, the objects he has in view in pursuing it, and in many cases upon his knowledge of mathematics; and we regret that Prof. Pickering seems occasionally to have chosen those which are likely to give the best numerical results, in preference to others which, depending more upon skill, are not indeed so suitable for the exact verifications of physical laws, but have a greater educational value in improving the powers of observation.

The method selected, for instance, for illustrating the laws of falling bodies is that of suspending a ball to a spring, which, when the connecting thread is severed and the ball allowed to fall, completes a galvanic circuit in which a chronograph is included, and which is again broken by the impact of the ball on a plate placed below to receive it. This method is well adapted to show the relation between the time of falling from rest and the distance traversed; but Attwood's machine, of which no account is given, illustrates the fundamental laws of dynamics much more completely, is capable, if fitted with proper electric arrangements, of giving extremely good results, and is better suited for use by the pupil, as in our opinion all such instruments ought at first to be used, with some means of measuring time, such as the stop-watch, water-clock, or metronome, dependent upon skill, and not upon a purely mechanical arrangement.

Some of the experiments described are avowedly given as a preparation to those who may have to give lectures on physics, and others are, we presume, inserted with the same intention, as it would hardly be necessary for those possessing that "moderate familiarity with the general principles of physics" which "the class is supposed to have previously attained" to spend time over the experimental proofs given of the laws of the composition of forces, or the equality of the angles of incidence and reflection.

The earlier pages of the book are devoted to general remarks on physical measurements, and on methods of working up the results of experiments, and they will prove very useful.

The knowledge of mathematics assumed throughout is small, and in several instances the line has in this respect been drawn too tightly, no account being given of the method of determining the coefficient of torsion by means of the torsion pendulum, or of the determination of gravity by the reversible pendulum, probably on account of the small amount of rigid dynamics required in these problems.

In a book, however, which must necessarily be intended for use by pupils of very different attainments, it would be difficult to avoid criticisms of this kind, and we think the experiments on the whole judiciously selected and clearly explained. We shall look with interest for the appearance of the second volume, and when finished "Physical Manipulation" will no doubt be considered the best and most complete text-book on the subjects of which it treats.

A. W. R.

OUR BOOK SHELF

Mineralogy. By F. Rutley, F.G.S. (Murby's Text Books.)

MR. RUTLEY'S little treatise on mineralogy has the merit of expressing in a clear and simple form the facts that are most wanted to be known by the general student of a science for which a small elementary English book is needed. The descriptions are concise, and the selection of the matter under each mineral generally good. Mr. Rutley, furthermore, gives some fifty pages of preliminary matter, which, though not always put in the most intelligible form, yet embodies a considerable amount of useful technical teaching in regard to the physical properties of minerals. Mr. Rutley even enters, and very rightly does so, on the subject of optical characters. But in these pages, as in the page on thermo-electricity, the author does not seem to have carefully revised what he wrote, or he would not have followed other authors in speaking of boracite as a uniaxal crystal, and would hardly have classed the dispersion of light by a diamond with the play of colour exhibited by an opal. Nor is an optic axis correctly described as the only direction by looking along which the doubly refracted images of a spot can be got to coincide, as Mr. Rutley will see if he looks at the spot through two opposite faces of the hexagonal prism of a calcite crystal. He ingeniously endeavours to indicate the nature of the faces of his crystals by a sort of heraldic hatching and marking. The use of small letters always indicating the character of the faces, as in Des Cloizeaux and other French treatises, might have done this usefully; Mr. Rutley's puzzling figures will probably only serve to scare away the English student, who needs every allurement to the study of the neglected science of crystallography—a science neglected merely because the rudiments of geometry and trigonometry are not made a necessary part of every scientific student's education. And it is a significant circumstance in connection with this neglect of scientific crystallography, that the geometrical methods and simple notation introduced forty years ago by our distinguished fellow-countryman, the first living crystallographer, Prof. Miller, are, we believe, untaught in any single lecture-room in London. Is England to be the last country to adopt a system made European by Sénarmont, Sella, Beer, and Grailich, and which is fast overcoming even in Germany itself a natural prejudice in favour of the more unwieldy, though in its time useful and ingenious, notation of the great Leipsig Professor?

Sanitary Arrangements for Dwellings, intended for the use of Officers of Health, Architects, Builders, and Householders. By William Eassie, C.E., &c. (Smith, Elder and Co. 1874.)

THIS volume gives, in a collected form, a series of papers published originally in the *British Medical Journal.* Its object, the author states, is to give "an account of the most ordinary sanitary defects in dwelling-houses and public institutions, in respect to drainage, water-supply, ventilation, warming, and lighting;" and "to set forth," what he believes, "the most simple and effective means of *preventing* or *remedying* such defects." He thinks it necessary to say further:—"The purpose of this small work is to point out, in the plainest language, what ought to be done to render ancient and modern houses healthy. I will eschew all extraneous matter, as much as possible, and will not fall into the common practice, better honoured in the breach than the observance, of heading the chapters, or interlarding the matter, with lines from the poets." It is but due to the author to say that he has faithfully avoided this tendency "to drop into poetry" on the subject of house-drains, sewers, &c.; on the plainness of the language, however, we cannot speak very highly. Many householders, it is to be feared, will find some difficulty in recognising an S-shaped pipe under the name of a "sigmoid"; or in appreciating the beauty of a description in which the overflow sewage from a cesspool is said to "debouch into the fields."

The greater part of the book is occupied with a description of the various sanitary appliances for buildings which have from time to time been proposed, or which have been brought into actual use. such as drain-pipes, of which twenty-two different kinds are figured and described; traps, of which thirty-six are given; fire-grates and stoves, &c. In many places, indeed, it reminds us of nothing so much as a manufacturer's or tradesman's catalogue. On the whole, however, this work contains much useful information and many excellent suggestions. On the subject of house-drainage, we are glad to see that Mr. Eassie has adopted and advocates the principle of leading all house-drains into one collecting drain, outside the house if possible, and placing in this main drain an efficient trap, properly ventilated, so as to prevent any of the sewer gases finding their way into the house through the drains or pipes.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Robert Brown and Sprengel

IN the notice of Mr. Darwin (vol. x. p. 80, bottom of 2nd col.) a mishap has somehow occurred which blunts the point intended to be made prominent and renders the statement untrue. I supposed that I had written "*And* we know from another source that he (Mr. Brown) looked upon Sprengel's ideas as *by no means* fantastic. Yet instead," &c. The object was to show how very near Mr. Brown came to reaching the principle that Nature abhors close-fertilisation in plants, and yet did not reach it at all. The authority for the statement I wished to make will be found in a footnote in Mr. Darwin's book on the "Fertilisation of Orchids," p. 340.

ASA GRAY

Cambridge, Mass., June 19

On the Physical Action taking place at the Mouth of Organ-pipes

THE most interesting, and perhaps the most important, fact disclosed in the experimental study of the organ-pipe on the air-reed theory is this—that the aeroplastic reed has a law of its own, unique amongst the phenomena heretofore observed in musical vibrations. It may be stated thus—*As its arcs of vibration are less, its speed is greater.* All our knowledge of rods and strings, of plates and membranes, would lead us to expect the usual manifestation of the law of isochronism, that in the air-reed considered as a free rod fixed at one end and vibrating transversely, the law would be observed, "though the amplitude may vary, the times of vibration will be the same." Yet here we meet with its absolute reversal, viz.—*the times vary with the amplitude.* This information does not rest on theory; every eye may verify it. A principle so strange, when first its action was observed, might well lead to disbelief in one's senses, although the mind had by its reasonings led up to the fact and sought for it as the one thing needed to give consistency to theory and make it a perfect whole. Familiar as the air-reed had been to me, the one secret had been hidden from my eyes; seeing, they saw not. Faith in the known mode of activity of the transversely vibrating rod had blinded me; and it was only after long reasoning, *forced* upon me by the presence of independent harmonics, not upon any theory belonging to a reed (whose first harmonic would be higher than an octave twelfth), that my faith was shaken. Then, *conceiving* the idea of this principle of action, I looked, hoping to find my reasoning confirmed; yet, let me confess it, the first sight of the reality startled me not a little with self-confusion. Here was an every-day *fact, constantly* before me it had been, beautiful in its simplicity, waiting to be acknowledged, and I so stupidly blind as not to see it. Vary the experiment, repeat it again and again, and the fact will be confirmed beyond possibility of doubt, that, the length of reed remaining unaltered, if by extraneous influence the pitch of the note is lowered whilst the pipe is speaking, correspondingly with the changing sound the path of the air-reed will be lengthened; or conversely if the pitch be raised, simultaneously with the quickened velocity, the air-reed will be seen to shorten its stroke; no swelling of tone gaining power with gain of amplitude; not the counterpart of a metallic reed, nor acting as a tuning-fork. The creature of air, it times itself to the element that sustains it. This aero-rhythmic law provides the only way possible to the air-reed to work out the transmutations of energy essential to its functions; the constitution of air necessitates the conformity in mechanical relations.

Another remarkable demonstration falls to this theory—that the note of every open organ-pipe is not single but is a concord, always consists of a duality of tone; the two distinct tones of the air-reed and of the pipe may be separated and again blended at pleasure.

Also that the harmonics or over-tones may in favourable pipes be brought on at will without alteration of the pressure of blowing; that likewise, when a pipe, instead of continuing to sound its fundamental, is unsteady, and gives its harmonic, the pipe being said to "fly off to its octave," the notion implied is erroneous; it can be rendered visible that the air-reed leaps back to its octave speed, and by its superior strength compels the pipe to follow in accord. The expression "leaps back," is deliberately used, for the native pitch of the air-reed is far higher than the harmonics of the pipe.

Add to these the still more singular feature of three different velocities concurring to produce in an open organ-pipe the one fundamental tone, which we call its pitch, the super-nodal wave having one velocity, and the sub-nodal wave having for its course and recourse *two differing* rates of progression. *The motion of vibration is an activity tempered by rests.* In every wind-instrument we perceive intimations that the period of rest is originally governed by the *special structure* of each, and experiment shows that we can arbitrarily limit or prolong it; this variable ratio of rest to activity is to be taken into account in all calculated times and velocities. In forming a true *conception* of the behaviour of musical reeds, and in tracing out the process of tone-making in organ-pipes and other wind-instruments, the modifying influence of the "rest," between the vibrations announces *itself* as of vital importance. If the doctrine is strange, it is not unnatural. The action of the heart furnishes a parallel instance—contraction, dilatation, pause—the three making up the rhythmic period of the heart's beat, and their relative duration varying with the individual organisation.

The foregoing affirmations are preparative. It will not be possible to condense into *one* letter the evidence and arguments supporting them, but if they are borne in mind during the progress of the exposition, the bearing of each new fact on theory will be more readily *seen, and* the aim and purpose of the reasoning be apprehended even in its incomplete stages.

There is one significant question which it occurs to me has never yet been asked; *that the node is to* be found in all longitudinal vibration of rod or pipe is undoubted; that there is a displacement of a node in an open organ-pipe is an accepted fact—but why, in rod or pipe, why is there a *node* at all? The question will wait.

Now to the experimental pipe. Suppose we have before us an open diapason organ-pipe, of section *rectangular, length* 7 ft. 6 in., interior breadth 4½ in., depth 6 in., area of mouth 4½ in. by 4 in., pitch C.C.—the half wave-length for this pitch is 8 ft. 8 in. in the atmosphere. The wind-way is a narrow fissure, barely *the twenty-fourth* of an inch wide; on the inner margin of this wind-way we place a card or plate, covering interiorly the whole area of the embouchure, and then we admit the wind-current *at the foot of the pipe* from the organ-bellows.

Premising that the swift-sequence of action is delayed for convenience of our analysis, we notice that the stream of air, and as yet it is *nothing more*, is directed slightly diverging from the vertical, and sufficiently to cause it to glide up the inclined plane of the lip. This stream is the life-force of the sound. "That everybody knows." *True they may.* But how many ever think, if they know, that its force is that of a storm-wind driving along at the rate of sixty miles an hour. The anemometer or wind-gauge proves *it to be so, and that* moreover in some stops of large organs the pressure per foot given by the bellows is equal to that of a hurricane.

If now the plate be removed from the back of the embouchure, the stream is instantaneously transformed into an air-moulded reed. There is gradation in the change, the order of which may be worked out, leaving the sound as Shelley says "waiting to be born."

The velocity *of passage* is to become endowed with a new power, the velocity *of vibration*. How is this investiture accomplished? How afterwards does the transversal vibration of the aeroplastic reed call into existence the longitudinal vibration of the air-column of the pipe?

The isolated reed, before any *change* takes *place*, has no innate tendency to swerve from uprightness, of itself it can neither blow in nor out, nor can the atmosphere influence it, for that is equal on both sides; the air-column within the pipe is *at rest*, it has no self-stimulating power of vibration, and to disturb its equilibrium some internal exciting cause is needed which shall produce, with determination of priority, condensation or rarefaction. It is obvious that the reed as it now stands has no power to produce a condensation, it does not strike against the sharp edge, it simply asserts its own upward-rushing force. The reed must be bent *before* it will vibrate. To cause this flexure the only alternative is rarefaction. The act of rarefying occupies time, it takes place within the pipe, is not spontaneous, but is induced by some *previous act, therefore the provocation* belongs to the reed. In velocitous rush over the mouth, its dense stream making around itself a rarefied atmosphere, it causes the approach of the quiescent column, carries off *all the particles of air lying* in the nearest layers, and would go on abstracting indefinitely if there were no counterbalancing causes coming into operation, but it brings down upon itself the power *that* bends it; *suction by velocity* has created a partial vacuum; the air-column, pressing outwards with the impetus of expansion, begins to bend the reed over, the excited air-particles of the interior not only press forward to fill the places of the lost, but eagerly crowd out upon the top of the reed, irresistibly sucked into the zone of rarefaction around the mouth, a region where velocity has ensured least pressure, and *through* this same "*law of least pressure*," there is a loss of support to the under surface of the reed, favouring the curve of flexure, the pressure varying and diminishing from the root upward.

As yet we have no vibration, for simultaneously with the exterior action the interior rarefaction is extending high upward, the air-particles are rallying from further *distances, awakened by* the agitation of those in advance, throughout the whole length and breadth of the pipe, uneasy as bees in a hive; whilst the particles are swarming toward the mouth, they are drawing away *from* the main body of their supports, their own elastic energy is diminishing, they are more and more thinned in numbers, and the new levies come up to the front exhausted of their early *vigour*. Now is the supreme moment of the reed's advantage, its watchful ally, the external air, pierces the weakest line just under the sharp edge of the lip, and dashing in as a wave of condensation with *cumulative* pressure, drives back the outflowing wave, and would restore equilibrium but that the air-column, still advancing, and pressed forward in consequence by the inroad of the upper *air, meets it in full* shock ere it has reached midway; meanwhile the air-reed, rising with vigour to recover its upright position, and following after its ally in the wake of the retreating column, *slightly overpasses* its own line, enters the pipe momentarily to be cast out again, for the wave of rarefaction is returning and vibration is established. The invading wave has been repulsed at the spot hereafter *memorable* as *the node*, and the conflict renewed and continued will chronicle no victory to either unless other and foreign forces are brought in, for, as I shall show, we have resources within command enabling us to sway the equipoise and give supremacy to the reed.

"I do suppose," as Dr. Hooke says in his talk on "springy bodies," "I do suppose the particles" behave, and that the action takes place in the manner I have described; the analogy is not strained, nor have I used one phrase in association of ideas which I do *not* think fully justified by the physical relations of the process. Therefore do not dismiss this as the sketch of a fancy battle. Watch for yourselves; place within the pipe at the back of the mouth some fine filaments of cotton, or fluff or down; advance them from the interior to the inner edge of the windway, and you will see them shot with energy not upward into the pipe, but outward full in your face with an unmistakeable trajectory. Do we not bring into activity the same force, "suction by velocity," when we blow through one little tube over another tube leading down to a well of perfume and draw up thereby scent-laden globules caught in the belt of wind passing over the tube's orifice, dispersing fine odour-sprays into the atmosphere? When a train of carriages loosely coupled is starting out of a railway station, should the engine suddenly back a little we see the hindermost portion of the train with its acquired momentum meeting the foremost portion advancing to it with reversed direction of impetus, and the central carriages receive a double compression, a rude kind of node is thus formed starting a reaction of bufferage in opposite directions, so when trains come into collision or are suddenly stopped in career, the distribution of weight, the gradients and relative velocities determine which portion feels most the influence of the shock. Again an analogy. There is a country custom, when the bees swarm to dredge them with flour as a means of identification, if the flour *travels* you will know the bees have journeyed likewise. Take a piece of white tissue paper (a bank-note answers it admirably), fold it so that a portion will occupy very nearly the space of the embouchure of the diapason pipe, by using a card it may be held level on the outer edge of the windway, it is in fact a paper reed but flaccid and inanimate; as you advance it to the windway no sooner is it caught in the current than it darts upright and becomes incorporated with the air-reed,

> "Grows with its growth and strengthens with its strength."

This same crisp little bit of paper will reveal to your eyes the treasured secret of the organ-pipe, tell you how its wealth of varied tone is wrought, show you its fine arcs of flexure, how it bends less for its inward than for its outward stroke, and how its free curves are moulded to your will; listen, and you shall hear the domestic wrangle of the reed and pipe; look, and you shall witness how in its high caprice it transmutes in a flash to harmonic speed and leaps exultant to its octave. Truly an Ariel imprisoned, endowed with form, and clothed with a white vesture making it in all its motion visible as bees.

On the supposition that the theory herein advanced is justifiable, the work of the aeroplastic reed is to be considered, specifically, *to abstract*. By reason of abstraction rarefaction ensues, condensation correlates therewith, the latter springing out of the former, and the product is vibration. The reed is the generator of the power and the node is the fulcrum of vibration, the place of reaction, with this peculiarity that it affords an elastic fulcrum sensitive to the encroaches of the column of air above it; in the stopped pipe on the contrary there is a stable unyielding fulcrum, and the results of this difference are very remarkable, as will be seen in another paper necessary to complete this exposition, but at present I can only allude in passing to one of these results which it seems desirable not to omit here. Admitting my affirmations so far as they can be proved by other eyes, objections will be taken to the imaginary description of the action of air-particles and waves in the interior of the pipe, as opposed to received doctrine. Novelty is often held to be outrage. It is an essential feature of my hypothesis that the initial movement, or prelude to vibration in the pipe, is distinct from successive movements both in its course and character; it extends throughout the pipe, is continuous but diminishing in degree, and is without a node, which is only fully established at the second course. Without entering now into further details it is important to notice that this interval between the first effort or gasp of the pipe and the full possession of its power, is distinctly perceived by the ear. All musicians acquainted with organs are conscious of this, and it is matter of usual comment with them how that stopped pipes are on the contrary remarkably quick of speech, instantaneous in articulation. They feel this without reasoning of why or wherefore As in stopped pipes there is no supernodal column, no requirement for an effort similar to that awakening motion to perfect vibration in open organ-pipes, the verdict of the ear is in both cases consistent with and corroborative of the hypothesis. Experiments with a very peculiar pipe called the "German Gamba" will throw invaluable light on the process of tone-making in organ-pipes.

HERMANN SMITH

The Degeneracy of Man

WITH regard to the culture of savages in Brazil the evidence of facts will be more esteemed by Mr. Tylor than the opinion of Dr. Martius, for Mr. Tylor has brought together a wealth of facts on the history and conditions of culture.

There is one class of facts which to my mind bears particularly on this question of the tribes of Brazil and the Amazons, and that is language.

The Kiriri and Sabuyah of Bahia as also the Ge have affinities with the Shoshoni and other dialects of the Rocky Mountains, and it is difficult to believe a language of this kind can belong to an epoch of high culture.

The dialects of the Tocautius have affinities of a like character with the Ankaras and Wun of Africa, and with that of the Akka pigmies just discovered in the Nile region.

The Purus, Coroado, and Corope of Rio Janeiro appear to belong to the Carib directly, and thereby also to Africa.

In the present state of our materials and information it is impossible to define exactly the members of each class. Thus the two groups last mentioned appear to be connected by the Baniwa and the Carib.

The main body of the population of Guarani, Tupi, Omagua, have by me been long since pointed out as having a language similar in roots and grammar to the Agaw of the Nile region. This is the highest development of language known to me in Brazil.

If the tribes of Brazil have fallen from a higher estate it is strange they should have become endowed with languages of the Prehistoric epoch.

HYDE CLARKE

June 29

THE gradual degeneracy of savage man from a higher type is a fact which an eminent author states in his letter in NATURE (vol. x. p. 146) to be difficult of belief. He wonders that Dr. Martius should say "the Americans are not a wild race, they are a race run wild and degraded."

The following facts seem to me to support the view held by Dr. Martius, Alex. von Humboldt, Abp. Whately, the Duke of Argyll, and others.

In the Ilium now laid bare by Dr. Schliemann, the lower strata contain more copper and fewer stone implements than the upper. "In other words, we have the very 'unscientific' fact of an 'age of stone' above an 'age of copper'" (Quart. Rev., April 1874). "The newly opened mound of Hissarlik stands as a lasting witness to a progressive decay of civilisation, industry, and wealth, among the successive races of its inhabitants" (Quart. Rev.).

Among the forest tribes of Brazil Dr. Martius found traces of the village community with its tribe-land common to all, while huts and patches of tilled ground were treated as acquired property, the recognised owners not being individuals but families. This may be well explained as a custom brought by Asiatic immigrants into the American continent. The Chinese anciently divided the land of a village into nine parts. The division was made by two perpendicular and two horizontal parallel lines. The middle square was common land. The eight remaining squares were assigned to eight heads of families, who cultivated the common square, giving the produce to the Government: they constituted a village. This principle of revenue collection based on land distribution existed for many centuries in ancient China, and was afterwards changed for a grain tax in kind about the time of the building of the Great Wall. Agricultural emigrants to America at any date before 200 B.C. would be familiar with this mode of doing things, and would naturally carry with them the knowledge of this and other customs existing at the time in eastern Asia. The appearance of a principle of land distribution resembling that of the old Teutons, among American tribes, cannot then be taken as proof that they were progressing and not degenerating, for it may, when our knowledge of ancient America becomes more accurate, be seen to be one of the lingering remains of an older civilisation which in a tropical climate favourable to indolence would easily decline. The religious beliefs and social customs of Asiatic and American races are in many respects so similar that there is abundant ground for questioning the originality of any civilised custom found among American tribes. Why should not comparative ethnology one day find the key to solve all such questions?

This fact, looked at from the eastern Asiatic point of view, is so far then from supporting the theory of progressive development, that it may rather be used as an additional buttress for the theory of degeneracy.

Names of number among Malayan and Polynesian tribes may be referred to as a proof of degeneracy. The sound "man" is 10,000 among the natives of Samoa and Tonga, as it is in Chinese, but it is 4,000 in the Sandwich islands, and 1,000 in New Zealand. Islanders avoid high numbers, and allow the significance of a name of high numbers to sink. This is proof of degradation. The reason why the arithmetical faculty among the New Zealanders has become weaker than elsewhere is because of their enormous distance from the continent of Asia. Samoa and Tonga are much nearer, and accordingly in those islands the religious traditions, *e.g.* circumcision, resemble those of Asia very closely. The Polynesians formerly had a decimal arithmetic, now it has sunk in Australia to quaternary or quinary arithmetic. In Ponape, one of the Caroline group, and comparatively near to the continent, *apuka* is 100 of men, trees, or yams, but 1,000 of eggs, cocoanuts, or stones. In Chinese *pak* is 100. After centuries of use high numbers fluctuate in value, because the intellect of islanders declines in power as the effect of long-continued isolation. The ideas, names, and usages of civilisation are gradually lost, and with them the human intellect becomes dwarfed.

Prof. F. Muller, after showing that the Polynesians could originally count to 100, adds, "Dies ist gewiss ein Zeugniss für die nicht geringe geistige Begabung und fruhzeitige Entwicklung dieser Volker."* The Polynesians, then, have sunk in power, and were, when visited by Capt. Cook, in a state of progressive degradation.

The question raised by Mr. Tylor was only—"Did Dr. Martius change his opinion about the degeneracy of Brazilian tribes?" Dr. Peschel thinks he did, but has not yet given sufficient proof. While I venture to think that the question—"Is savage man a degenerated being?" can be solved in the affirmative by the careful comparison of facts, without our needing to know that each scientific traveller holds this view, it would be most interesting to be assured that all such men are agreed upon it.

JOSEPH EDKINS

Disuse as a Reducing Cause in Species

IN a letter of mine (NATURE, vol. ix. p. 361), entitled "Natural Selection and Dysteleology," there occurs a footnote upon the above subject. As this footnote was rather carelessly written, I wish to explain my meaning more clearly.

In the first place, it is evident that the fact of disuse causing atrophy in individuals is no proof that it likewise causes atrophy in species; for if it does so, the laws under which it operates in the two cases must be quite different—the one set being as exclusively related to Inheritance, as the other set are independent of this principle. The primary question therefore is: Does inheritance here reproduce the character of immediate ancestors, as in congenital atrophy, &c.; or of distant ancestors, as in mutilations, &c.? I think there can be no reasonable question that it does the former, and so have no doubt that disuse is a cause of atrophy in species. The question as to degree, however, remains.

One sentence in the footnote I am explaining may be taken to imply that the effects of disuse are exhausted in a few generations. Nothing can be further from my meaning. If disuse acts at all in species, its *modus operandi*, as just stated, must be that of *causing* variations which are capable of being inherited; consequently, if disuse acts thus at all, it is impossible to assign limits to its operation in time. The question, however, is, In what proportion are the effects of disuse in the parents reproduced in the offspring? Variations caused by disuse certainly differ from congenital variations, in that they are not fully inherited; and it is the degree in which they are inherited that must determine the rate at which disuse here operates. This degree, however, is unknown: we only know that it is something very small. Now as disuse is in competition with other reducing causes, the rapidity of its action is an important factor in the estimation of its probable effects.

By the omission of the word "proportional" near the end of the footnote, I appear to institute an absolute comparison between the effects of disuse in wild and in tame species. This, of course, would be absurd. What I mean is, that supposing disuse to be the chief cause of atrophy in wild species, it has not produced so much effect in tame species as we should antecedently expect; for, although the facts are very scanty, so far as they go they tend to prove, that when an organ is disused for several generations only, the rate of its reduction is much greater than it ought to be, supposing disuse to be the main cause of atrophy in our domestic animals, and supposing the action of this cause to be uniform.

It will be asked, If we thus in part reject this cause, what other have we to substitute? This, of course, is a collateral issue; but as it is an important one, it may here be discussed. I would suggest the cessation of selection (see NATURE, vol. ix. p. 440) as a co-operating cause, for it seems to me that this *must* have acted here to some extent, and if no other causes have been at work, this extent must be the complement of the effects due to disuse. For the sake of definition, therefore, we shall assume disuse to be in abeyance. Now, on this assumption, we should expect to find that atrophy proceeds more rapidly during the initial stages of reduction than subsequently. But without dwelling upon this point, what may we infer from the existing degree of atrophy in the affected organs of our domestic animals? Supposing the cessation of selection to be the only cause at work, what degree of atrophy should we here expect to find? Before I turned to the valuable measurements given in the "Variation," I concluded (Cf. NATURE, vol. ix. p. 441) that from 20 to 25 per cent. is the maximum of reduction we should expect this unassisted principle to accomplish, in the case of natural as distinguished from artificially-bred organs. Now, on calculating the average afforded by each of Mr. Darwin's tables, and then reducing the averages to parts of 100, I find that the highest average decrease is 16 per cent., and the lowest 5; the average of the averages being rather less than 12. Only four individual cases fall below 25 per cent., and of these two should be omitted (Cf. "Variations," p. 272). Thus, out of eighty-three examples, only two fall below the lowest average expected. Moreover, we should scarcely expect disuse alone to affect in so similar a degree such widely different tissues as are brain and muscle. The deformity of the sternum in fowls also points to the cessation of selection rather than to disuse. Further, the fact that several of our domestic animals have not varied at all is inexplicable upon the one supposition, while it affords no difficulty to the other. We have seen that disuse can only act by causing variations; and so we can see no reason why, if it acts upon a duck, it should not also act upon a goose. But the cessation of selection depends upon variations being supplied to it; and so, if from any reason a specific type does not vary, this principle cannot act. Why one type should vary, and another not, is a distinct question, the difficulty of which is embodied by the one supposition, and excluded by the other. For, to say that disuse has not acted upon type A, because of its inflexible constitution, while it has acted on a closely allied type B, because of its flexible constitution, is merely to insinuate that disuse having proved itself inadequate to cause reduction in the one case, it may not have been the efficient cause of reduction in the other. But the counter-supposition altogether excludes the idea of a casual connection, and so rests upon the more ultimate fact of differential variability, as not requiring to be explained. Lastly, it is remarkable that those animals which have not suffered reduction in any part of their bodies are likewise the animals which have not varied in any other way, and conversely; for as there is no observable connection between these two peculiarities, the fact of the intimate connection between them tends to show that special reduction depends upon general variability, rather than that special variability depends upon special reducing causes.

Dropping, however, our argumentative assumption, it will be remembered that I deem it in the last degree improbable that disuse should not have assisted in reducing the unused organs of our domestic animals; and the effect of this remark is to show that the cessation of selection is not able to accomplish so much reduction as I antecedently expected. On the other hand, it seems to me no less improbable that the cessation of selection should not have here operated to some extent; but in what degree the observable effects are to be attributed to this cause, and in what degree to disuse, I shall not pretend to suggest.

No doubt the above considerations are of a very vague description; but this only follows from the scarcity of the data at our disposal, and it is to this very scarcity that I am principally desirous of calling attention; for although it is with reluctant diffidence that I venture thus, even in part, to dispute the doctrine of one whom most of living men I venerate, yet, for the reason just given, I cannot help feeling that the time has not yet arrived for a final quantitative decision upon this subject. However, as before remarked, "the question thus raised is of no practical importance; since whether or not disuse is the principal *cause* of atrophy in species, there is no doubt that atrophy *accompanies* disuse."

GEORGE J. ROMANES

---

* "Reise der Novara" Linguistischer Theil, 1867, p. 287

Longevity of the Carp

LAST autumn, being at Fontainebleau, I was told by the servant of the Palace there that the German soldiers while in occupation of the place during the last war caught many of the carp in the pond of the Palace garden called "Jardin Anglais," and that some of these carp carried, attached by silver wire to their gills, little silver plates bearing inscriptions purporting that the plates were attached to the fish in the time of Francis I. and Henry II.—*i.e.* about 300 years ago.

Some of your German readers could easily ascertain by inquiry of the corps in occupation whether such fish were in fact caught. If it should turn out that they were, then, although the well-ascertained proof desired by Mr. Suffield (NATURE, vol. x. p. 147) would not of course be given, yet the fact would be evidence worth noting.

F. G.

Cannes, June 28

THE "CHALLENGER" EXPEDITION *

V.

INACCESSIBLE AND NIGHTINGALE ISLANDS

THE first of these islands, the area of which is about four square miles, is situated about twenty-three miles W. by S. of Tristan d'Acunha. The cliffs rise to the height of about 1,000 feet in a perpendicular range on the north-east side. The tract beneath the cliffs is covered with *débris* of fallen rocks. On the cliffs themselves the plants are similar to those found in the same situation in Tristan. On the lower land are dense thickets of *Spartina arundinacea* Carm., a tall, reed-like grass, which here forms an extensive penguin rookery; patches of *Phylica arborea* Th. also grow on the summits of slight elevations; and under the shelter of the cliffs the trees attain a height of twenty feet, or even more. The trunks are seldom or never straight, but mostly lean over, or become partly procumbent, starting upright again towards the top. The largest trunk seen by Mr. Moseley measured a foot in diameter, but the trees on the upper plateau are said to measure 18 inches across, they do not, however, grow so high, being stunted by the force of the gales. The wood of the *Phylica*, though brittle, is said to be useful when properly dried, but in exposed situations it rapidly decays. Underneath the trees are ferns, mosses, and sedges, also *Acæna sanguisorbæ* Vahl., the leaves of which are used in New Zealand both as a tea and as a medicine. *Chenopodium tomentosum* Th., the tea-plant of Tristan, also grows in abundance, forming bushes with woody stems. A species of *Sphagnum*, *Carex insularis* Carm., and *Hydrocotyle capitata* Th. grew in a swamp near the penguin rookery. From the two Germans who were discovered on the island a good deal of information was obtained about the vegetation, more especially of that of the higher land, to which it was found impracticable to ascend from the side of the mountain where the ship anchored. The plants found there were similar to those which grew below, but in addition grew the species of *Empetrum*, found on the other islands, *Lomaria boryana* Willd., which in some instances attained a height of four feet, *Lycopodium insulare* Carm., and *Lagenophora commersonii* Cass., a small Composite plant with a daisy-like flower. The Tussock grass, which appears closely similar to *Dactylis cæspitosa* Forst., of the Falklands, grows in patches of considerable size on the upper plateau, and straggles up the cliffs to the summit. *Nertera depressa* Banks also grows on the plateau, and its berries form a favourite food of the *Nesocichla eremita*, the native thrush of the Tristan group; while the Bunting (*Emberiza brasiliensis*) feeds on the fruits of the *Phylica*.

The two Germans had cultivated the ground in the neighbourhood of their dwelling, growing potatoes, cabbages, and other European vegetables. Two species of clover also introduced by them were spreading rapidly, and a convolvulus was growing in quantity on the cultivated ground.

The other island of the Tristan group is named Nightingale Island, and is distant 20½ miles from Tristan d'Acunha, and 12 miles from Inaccessible Island. It is, comparatively speaking, a mere speck about one square mile in extent, and to the west are two small outlying islands covered with Tussock grass. A rocky peak 1,100 ft. high rises on the north side of Nightingale Island and is continued into a ridge stretching across the island, a valley separating this from a lower ridge which runs nearly at right angles. On the lower tract *Phylica arborea* occurs in patches, and on the high ground was seen *Lycopodium insulare* and a species of *Cotula* different from that found in Tristan and not seen at all in Inaccessible Island. *Sonchus oleraceus* L., which grows abundantly on the other islands, is, together with several other plants, absent from this. The Tussock grass forms a dense growth over nearly the whole island, growing in thick tufts or clumps to a height of five or six feet, and so matted together near the base of the clumps as to be almost impenetrable. The abundant growth of this grass causes the island to become an enormous penguin rookery, and the thick deposit of the excrement of the birds imparts a greater vigour to the plants, so that the lower parts or bases of the clumps become of a peaty character, beds several feet in thickness, of a black peaty richly-manured soil, being thus formed. It was with the greatest difficulty that a way was made through this thicket, the grass being too high to allow the planning of any definite track, and the screaming and biting of the penguins, together with the stench from the thick deposit of dung, being anything but agreeable. Indeed Mr. Moseley says that the specimens of Tussock grass which he gathered on Inaccessible and Nightingale Islands were lost in the continued fight with the penguins and the long grass. In one place a quantity of the trees of *Phylica arborea* had been blown down by the wind, and the trunks were lying dead on the ground. Lichens, as well as two fungi, were found on these dead trunks.

A dark green ulva forms a thin coat on the rocky shelves of the coast near the caves of the seals, which, when dry, as was the case during the *Challenger's* visit, has a peculiar metallic appearance. The island is never visited except during the sealing season.

Though it has been stated that the vegetation of the Tristan group knows no change of seasons, it is proved that some of the plants mentioned in these notes have their periods of flowering; thus the *Pelargonium* is said to flower in the middle of the summer, when a large number of the flowering plants are at their best, and the shore is covered with the fallen petals. At the time of the *Challenger's* visit in October few plants were in flower, but the phylica trees all bore fully developed green fruits.

From the geological as well as the botanical similarity of the three islands forming this interesting group, it may be surmised that a former connection existed between them. The different currents which sweep the Tristan group bring with them many foreign seeds, which are cast up on the shore. Amongst them was seen those of *Guilandina*, which are sometimes washed up on the Irish coast by the Atlantic current. These seeds are known in Tristan d'Acunha, as well as in Bermuda, where they are also occasionally cast up, as the sea-bean, the popular belief in the islands being that they are the seeds of a plant which grows at the bottom of the sea.

THE FIGURE OF THE EARTH IN RELATION TO GEOLOGICAL INQUIRY

THE elevation and depression of different parts of the surface of the earth above or below a mean ocean level has frequently formed the subject of communications to NATURE, but in no instance, as far as I am aware, have any of these changes been referred to the remarkable shape of the equatorial circumference of the earth, and to the changes which it is not improbable are constantly but slowly taking place in the position of the major and minor axes of the equatorial circumference. On p. 98 of the second edition of "The Heavens," by Amedée Guillemin, edited by J. Norman Lockyer, F.R.S., the following note is introduced in brackets by the editor:—

---

* These Notes are founded on letters addressed to Dr. Hooker by Mr. H. N. Moseley. Continued from vol ix. p. 456.

"The most recent results arrived at by geodesists have taught us that the earth is not quite truly represented by an orange, at all events, unless the orange be slightly squeezed, for the equatorial circumference is not a perfect circle, but an ellipse, the larger and shorter equatorial diameters being respectively 41,852,864 and 41,843,896 ft. That is to say, the equatorial diameter which pierces the earth from long. 14° 23′ east to 194° 23′ east of Greenwich is two miles longer than that at right angles to it."[*]

The history of these "results" may be briefly stated as follows:—

Capt. Clarke, R.E., in a communication to the Royal Astronomical Society, read April 6, 1860, and published in vol. xxix. of the "Memoirs," investigates the figure of the earth resulting from the best existing data. He concludes:—

"The result of our investigations then is this: that the ellipsoid which best represents the existing meridian measurements has its major (equatorial) axis in longitude 13° 58′·5 east from Greenwich."

The greatest and least values of the meridian compression are—

$\frac{a-c}{c}$ . . . . $\frac{1}{286\cdot779}$ in longitude 13° 58′·5 E.

$\frac{b-c}{c}$ . . . . $\frac{1}{309\cdot364}$ in longitude 103° 58′·5 E.

and the length of the polar semi-axis, 20,853,768 ft. "The difference of the equatorial semi-axis is 5,308 ft., or, in round numbers, just one mile."

The investigation from which result the above figures was undertaken by Capt. Clarke, in consequence of remarks by the Astronomer Royal in the "Monthly Notices" of the Royal Astronomical Society, vol. xx. p. 104 (January 1860), on General Schubert's "Essai d'une détermination de la véritable figure de la terre." The results arrived at in General Schubert's memoir is that the earth is an ellipsoid, whose elements are—

Polar semi-axis . . . . . 20,855,605 ft.

Maximum compression . . $\frac{1}{292\cdot109}$

Minimum " . . $\frac{1}{302\cdot004}$

Longitude of major axis of equator . . . 41° 4′ 221° 4′

" minor axis of equator . . 131° 4′ 311° 4′

the longitudes being measured from Greenwich eastwards.

For the dimensions of the earth on the elliptic hypothesis, Capt. Clarke prefers the following values, given at p. 773, of the "Account of the Principal Triangulation (Ordnance Survey)," viz.—

Equatorial . . 20,926,348 ft. }
Polar . . 20,855,233 ft. } Compression $\frac{1}{293\cdot76}$

Mean degree . 364,613·33 ft.

The volume was published in 1858.

It appears, then, that somewhere between long. 13° and long. 41° east of Greenwich the major equatorial axis is about two miles longer at the present day than the equatorial axis at right angles to it; and during earlier geological epochs, when the crust of the earth was in a more plastic condition, these differences may have been considerably greater, and the effect on the geological structure of the earth intensified.

The point to which I wish to draw the attention of those who have studied the successive variations in the level of certain parts of the earth's surface, relates to the effect which this equatorial "bulge" must have produced upon various geological phenomena, and particularly if the longitude of the bulge varies according to a determinable law.

It will be readily seen that its influence will be felt—

1. On the elevation and depression of the land, especially near the equator.
2. On simultaneous elevation and depression on opposites sides of the earth.
3. On ocean currents, consequently on climate, &c.
4. On the thickening and thinning of formations to the east and west.
5. On the flow of rivers, hence on river and lake terraces, beaches, &c.

Observed facts, especially in North America, appear to show that the subsidence and subsequent elevation of that continent has always taken place very gradually and with a progressive motion from west to east and from east to west. In other words, these changes of level have assumed the form of a vast equatorial undulation progressing with extreme slowness, at one epoch in an easterly, and at another in a westerly, direction. This appears to be shown by the very gradual thinning out, or the very gradual thickening, of Tertiary, Cretaceous, and even Palæozoic formations. In Post-tertiary times, where we are brought nearer to the records of past changes, and may compare antipodal illustrations, it is apparently manifested by the stupendous escarpments which for 1,000 to 1,700 miles rear their wall-like fronts from 200 to 600 ft. above the Ontario, Red River, and Saskatchewan plains; and it is further indicated by the symmetrical river terraces and lake beaches which are developed to a very remarkable extent throughout the whole of the northern part of North America.

These occur both on the east and west flanks of the Rocky Mountains, and are found in the various passes *through* that great range. To enumerate examples would be to select any large river issuing from the Appalachian Chain, the Laurentides, or the Rocky Mountains, at elevations varying from 400 ft. to 4,000 ft. above the present level of the sea. I hope that some of your correspondents may supply illustrations of similar geological phenomena occurring as near as it may be possible to find records on opposite sides of the earth and during the same geological period of time.

To the supposed motion of the equatorial bulge may also be partly attributed the changes in the direction of the flow of certain rivers, and the elevation of an axis across the North American continent from east to west between lat. 35° and 45° N., by which the drainage of the great Canadian Lakes (excepting Ontario) was diverted from the Gulf of Mexico into the Gulf of St. Lawrence. The ancient river channels through which the great lakes sent their waters to the sea are now filled with drift to a depth varying from 200 ft. to 600 ft. During the period of depression the great lakes were in direct communication with the sea, and their waters were brackish or salt. The dredging operations which have been conducted in Lake Michigan show the former marine character of the fauna of the waters of this lake.

The origin of beaches and terraces appears to be intimately connected with an easterly or westerly progress of elevation simultaneously with a northerly and southerly elevation, such as would be produced by the slow movement of an equatorial bulge in an east or west direction. In North America, where terraces and beaches exist in perfection at altitudes varying, as already stated, from 400 ft. to 4,000 ft. above the ocean, the phenomena may be studied with some prospect of elucidation.

I have been credibly informed that data do not at present exist which would enable astronomers to state definitely that the bulge in the equatorial circumference of the earth between longitudes 13° and 41° east of Greenwich is stationary, or whether it has an easterly or westerly motion, and thus partakes of the character of an undulation. Perhaps, on consideration of the causes which produce this ellipsoidal form of the equatorial circumference of the earth, we may assume that the longitude of the major axis is constantly changing and progressing from west to east within certain limits, and then returning from east to west; in other words, oscillating through a determinable space.

---

[*] Mem. R.A.S. vol. xxix 1860.

I have ventured to bring this interesting subject under the notice of the readers of NATURE in the hope that it may receive the attention which it appears to merit, and that satisfactory illustrations will be forthcoming to show that the differences between the equatorial major and minor axes of the earth are competent to explain or throw light on many disputed points in geological inquiry, and to lead to a rational solution of some difficult problems. On the other hand, it does not appear unreasonable to suppose that known geological facts may serve to point out a line of investigation which may lead to a more correct knowledge than we appear to possess at present of the figure of the earth, the probable changes which are slowly taking place, and the relation which these bear to geological inquiry. HENRY Y. HIND

Windsor, Nova Scotia

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL" *

V.

WHEN the investing bones, mentioned in the last paper, are removed, the chondro-cranium of the axolotl is seen to have a far lower structure than that of the salmon. The hinder part of the skull-floor is constituted by a flat plate of cartilage (Fig. 13, B.O) formed from the investing mass, and answering to the basi-occipital, but unossified. From this rises up on each side a narrow cartilaginous pedicle, which, uniting above with its fellow, forms the occipital ring inclosing the foramen magnum. An ossification—the exoccipital—is formed on each side of this arch where it bears the occipital condyles; but, as in all amphibia, the supra-occipital, like the basi-occipital region, remains cartilaginous.

From the front edge of the basilar plate proceed two cartilaginous rods, uniting between the nose capsules as an expanded inter-nasal plate (I.N) and rising up to form the walls of the brain-case, but leaving its floor and roof to be covered in by the investing bones—the parietals and frontals above and the para-sphenoid below. These rods are, clearly, the very slightly altered trabeculæ; they bear a single pair of ossifications, placed considerably in front of the optic foramen, and answering to the lateral elements of the "os en ceinture" or "girdle-bone" of the frog. The nasal capsules, situated immediately outside the expanded cornua trabeculæ (hypo-trabeculars), are, as far apart as in the ray.

The auditory capsules are largely cartilaginous, but contain three bones—the prootic, the epiotic, and a small ossicle nearly filling up a membranous space in the capsule between the prootic and opisthotic regions; the space is the first appearance of a *fenestra ovalis*, the bone of a *stapes*, so that in the tailed Amphibians is seen the earliest foreshadowing of the delicate apparatus by means of which vibrations of the air are communicated to the membranous labyrinth. The apparatus is, however, in a very rudimentary condition, there being neither tympanic membrane nor external meatus, and the stapes being connected, not with a chain of ear-bones, but with a band of fibres, the stapedio-suspensorial ligament (s.s.l), which unite it with the hinder part of the suspensorium.

The upper end of the mandibular arch is not let down to a considerable distance from the skull like that of the salmon, but forms the whole of the suspensory apparatus of the lower jaw, thus taking on the function performed in the fish by the proximal portion of the hyoid arch. The suspensorium is a stout cartilage sloping downwards and forwards, rounded below into an articular surface for the jaw, and divided above into three processes, the pedicle (p) or true apex of the arch, the ascending process (a), and the otic process (o). The two former are coalesced with the hinder ends of the trabeculæ, the latter with the auditory capsule; the first division of the fifth nerve passes out between the pedicle and the ascending process. A granular deposit of calcific matter (Qu) in the lower part of the suspensorium is the only representative of the bony quadrate of the fish, the meta-pterygoid region remains wholly unossified.

The pterygo-palatine arcade is very rudimentary, being represented only by a thin bar of cartilage (Pl Pt) passing forwards from the front edge of the suspensorium, but not coming into contact with the ethmoidal region. Two bones are, however, developed in connection with this cartilage—the small tooth-bearing palatine, and the enormous triangular pterygoid.

As in the salmon, the lower jaw, stripped of its investing bones, consists of an articular and Meckel's cartilage; the latter, however, is large and stout, and not reduced to a more slender root on the inner side of the dentary.

The hyoid apparatus (Fig. 12) is a strong bar of cartilage connected by ligament with the suspensorium and mandible; it is divided into cerato- and hypo-hyal, but is entirely unossified, and never comes into relation with the auditory capsule. The branchial arches are four in number; the two hinder are split up into a long epi-branchial, a short cerato-branchial, and a small wedge-shaped basi-branchial.

One of the most important points to be noted in the development of the skull is the formation of the stapes; this was formerly believed to be the apex of the hyoid arch, but its true nature—as a separated portion of the wall of the ear capsule—has been demonstrated in the frog, and confirmed in the newt, axolotl, and other forms. In the axolotl of about an inch long a crescentic slit is seen in the auditory capsule, formed by the degeneration of its cartilage into fibrous tissue; the ends of this slit extend and meet, and thus cut off a circular plug of cartilage set in a ring of fibre, producing at once the stapes and the fenestra ovalis.

The investing mass remains long in the condition of indifferent tissue, and even after chondrification has set in the two halves remain separate until a very late period, thus approximating to the state of things found in Menobranchus and Proteus, in which the two parachordals are permanently united only by fibre.

The trabeculæ are at first parallel with the post-oral arches, and only at a comparatively advanced stage come to lie almost at right angles to them, as in the first stage of the salmon. The pterygo-palatine process is very late in its development, arising as a bud from the mandibular arch, and growing forwards towards the trabeculæ, with which, however, it never actually unites. The minor changes which the arches undergo will not be described here, as they have been worked out at far greater length in the frog.

VI. *Skull of the Frog* (Rana temporaria).—As far as its general aspect is concerned, the skull of this well-known Batrachian is by no means unlike that of the axolotl: it presents, however, many important differences, and shows a marked advance towards the sauropsidan and mammalian type.

Among the most important of these characters may be mentioned the backward slope of the suspensorium (see Fig. 14), the large size of the maxilla and its connection, through the intermediation of a small separate bone (the quadrato-jugal, Q.Ju), with the quadrate, the union of the palato-pterygoid cartilage with the ethmoidal region, the disappearance in adult life of the branchial arches, and, most important of all, the separation of the upper end of the hyoid arch as a chain of auditory ossicles, for the purpose of communicating the vibration of the tympanic membrane to the stapes.

---

* Continued from p. 108.

Certain noteworthy peculiarities may be mentioned, with regard to the investing bones, the chief being the fusion of the parietal and frontal into a single bone (Fr.Pa), the dagger-like form of the para-sphenoid, and the addition of a horizontal bar to the upper end of the squamosal which seems to answer to one of the bony plates developed in ganoids in the temporal region, while the vertical portion is clearly the homologue of the pre-opercular. An extremely small membrane-bone is also developed in connection with the external nasal opening: this is the septo-maxillary (S.Mx), which is interesting from its reappearance in lizards, snakes, and birds.

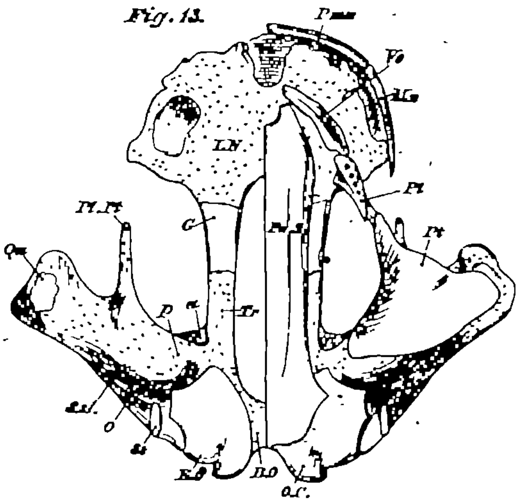


FIG. 13 —Skull of fully adult Axolotl, under view (× 2 diam), the investing bones being removed from the right side. I.N, inter-nasal plate; p, pedicle, a, ascending process, and o, otic process of the suspensorium.

In the cartilaginous brain-case the form of the trabeculæ is entirely lost by the complete union of those arches below, so as to form a solid floor of cartilage within the para-sphenoid, and by the formation of a roof of like character beneath the fronto-parietals: the latter is interrupted by a large anterior and a pair of small posterior fontanelles. Just behind the inter-nasal plate a stout dice-box-shaped ossification is developed (G) overlaid above by the frontals and below by the para-sphenoid; this is the girdle-bone ("os en ceinture" of Cuvier), and answers to the hinder part of the ethmoid, the fore part of the pre- and orbito-sphenoids, and the pre-frontals. In its posterior half this bone contains a single cavity, in which are lodged the olfactory lobes of the brain, but in its anterior moiety a vertical partition (mesethmoid) divides it into two chambers, through which the nerves of smell pass to the nasal sacs.

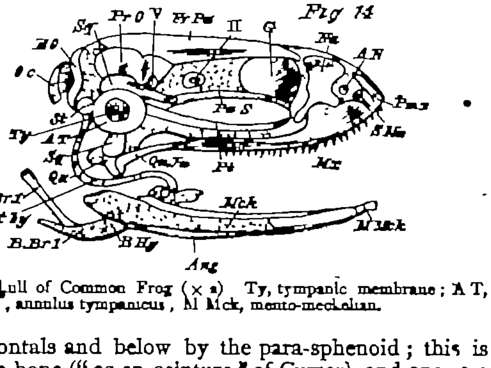


FIG. 14.—Skull of Common Frog (× 2) Ty, tympanic membrane; A T, annulus tympanicus, M Mck, mento-meckelian.

Only a single bone occurs in the auditory capsule—the prootic, which extends backwards, so as almost to meet the exoccipital; the opisthotic, epiotic, and stapes remain entirely cartilaginous.

The palatine (Fig. 15, Pl) is a slender bone not provided with teeth; the pterygoid is 3-ranged, having an anterior process coming into relation with the palatine, a posterior articulating with the auditory capsule, and a descending bar which runs along the inner side of the suspensorial cartilage; the two latter help to inclose the eustachian opening (Eu). The suspensorium does not present that clear division into pedicle, ascending process, and otic process which is observable in the axolotl; the second of these is, in fact, represented only by fibrous tissue, while the pedicle and the otic process are completely fused with the auditory capsule.

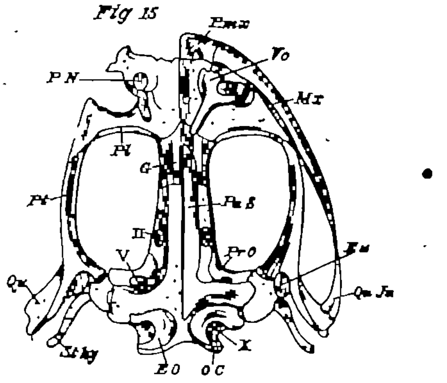


FIG. 15.—Skull of Frog, under view (× 2). the investing bones removed from the right side. P.N, posterior nares, Eu, aperture of eustachian tube.

There is no articular bone in the mandible, but an interesting ossification (M.Mck) of Meckel's cartilage takes place at the point of union of the two rami. This is the symphysial ossification or "mento-meckelian" bone; it has been found in the sturgeon and also in early stages of the human subject.

The hyoid arch is divided into two portions, an upper, which subserves the function of hearing, and a lower, which supports the tongue. The first of these (Fig. 16) is a hammer-shaped apparatus, partly cartilaginous, and partly bony, the handle of which articulates with the stapes (St), while the head is fitted into the drum-membrane (Fig. 14, Ty).* The parts of this ossiculum auditûs have been named by Prof. Huxley, in their relation to the stapes, inter-, medio-, extra-, and supra-stapedial; taken together they answer to the hyo-mandibular and symplectic of a fish. The medio-stapedial (M.St) is ossified; the other portions of the apparatus are cartilaginous. The tongue-cartilage is a shield-shaped plate consisting of basi-hyal in its anterior and basi-branchial in its posterior part, and connected with the skull by two slender, spring-like rods, the stylo-hyals (St.Hy), which are fused with the auditory capsule; these answer to the anterior or lesser horns of the hyoid bone of man, the greater horns being represented by the ossified first hypo-branchials or thyro-hyals (H.Br. 1) which embrace the larynx.

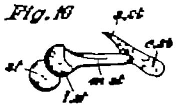


FIG. 16 —Ear-bones of Frog (× 4). i.st, inter-stapedial; m.st, medio-stapedial, e.st, extra-stapedial; s.st, supra-stapedial.

---

* The annulus tympanicus (A T), or ring of cartilage which supports the drum-membrane, would seem to answer rather to the external ear of a mammal than to the tympanic bone.

FERTILISATION OF PAPILIONACEOUS FLOWERS—CORONILLA

IN NATURE, vol. vi. pp. 478 and 498, you inserted a paper of mine in which an attempt was made to draw certain general conclusions concerning the fertilisation of papilionaceous flowers from the examination of a few genera, chiefly English: and in that paper I stated that the foreign genus *Coronilla* presented peculiar difficulties. I have since then been stimulated by Mr. Darwin's kind interest to examine *Coronilla* more carefully, and now send you the results.

The ultimate result of these generalisations was that in all the following particulars, viz. the position and motion of the flowers and the peduncle, the cohesion of the petals, the cohesion of the stamens (so remarkable a feature in this tribe); the structure and character of the filaments, of the anthers, and of the pollen, the structure of the style and stigma; and the place where nectar is secreted; the parts and functions are so organised and correlated as to induce and compel insects, generally bees, in visiting the flowers for nectar, to carry away with them pollen from one flower and bear it to another.

One, perhaps the most striking, of the generalisations in question was as follows:—

"The degree to which the cohesion of the stamens is carried, so remarkable a feature in this tribe, seems to depend on the necessity for access to nectar. In those flowers in which the stamens are monadelphous, viz. Ulex, Sarathaumus, Genista, Cytisus, Ononis, Lupin, there is no symptom of nectar within the staminal tube, no space for it, and no access to the interior. In some, at any rate, of these, viz. Ulex, Ononis, and Lupin, the bees certainly resort to other parts of the flower. On the other hand, where the tenth stamen is entirely free or where it is separated from the others at the base, so as to give an insect access to the interior of the staminal tube, there is nectar within this cavity."

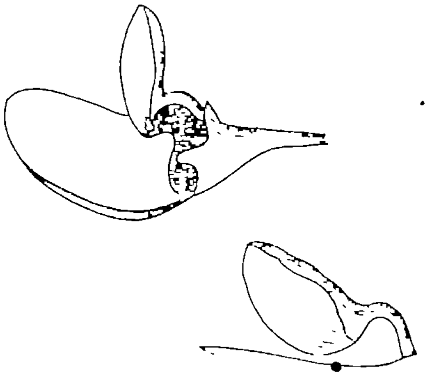


FIG. 1.—Coronilla varia.

To this generalisation the two species of *Coronilla* which I had examined, viz. *C. varia* and *C. glauca*, seemed to form an exception. In them the tenth stamen was always separate; but there was no aperture at the base of the staminal tube, no nectar within the staminal tube, and no space for it, the base of the staminal tube fitting as closely round the pistil as it does in those papilionaceous flowers in which the tenth stamen is not separated from the rest.

I have since had an opportunity of examining several species of *Coronilla*, and of watching large plants of *C. varia* (Fig. 1) and *C. emerus* (Fig. 2) in full flower. In all these flowers there is a peculiar structure of the petals. The claw of the vexillum is thin, sometimes prolonged and straight as in *C. emerus*; sometimes shorter and curved as in *C. varia*. The claws of the other petals cohere so as to form a channel, in which the staminal tube lies. But in all cases there is, immediately above the calyx, a large open space between the claw of the vexillum and the claws of the other petals so as to have free access from the outside to the inside or the inside to the outside of the flower.

One hot day last August I watched a bee rifling the flowers of *C. varia* in the regular way. He settled as usual on the lower flowers of the crowded umbel first, resting on the wings and keel, and went rapidly round and up the umbel. The plant was a large one, and he must have been there more than half an hour. He did not seem to be taking pollen. What could he be doing? for there was no semblance of nectar either inside the base of the petals or calyx or inside the staminal tube. On examining the flower carefully with a glass the *outside* of the calyx, which is thick and fleshy, appeared to be covered with shining glands or vessels, sometimes I think moist, but always yielding copious liquid on very slight pressure. Could this be what the bee was seeking? On a subsequent day I again watched a similar bee rifling the flowers, and at last distinctly saw his proboscis, which had entered as usual by the front of the flower, protruded outwards through the gap between the claws of the petals and sweep the outside of the calyx. Here then was an answer to my difficulty. The nectar for which the bee sought the flower, and in getting which he benefited the plant by carrying pollen from flower to flower, was not in any of the usual places inside the flower, but outside the calyx, while there was a very peculiar construction of the petals giving access to it. Instead of proving an anomalous exception to the generalisations I have quoted above, it turns out to be another curious illustration of the various ways in which the same function of secreting nectar and of attracting the bee to it in the manner requisite for fertilising the flower is effected by different organs. That the outside of the calyx should secrete nectar and that there should be a peculiar window, out of which the bee, having entered by the regular door, and having in so doing dusted himself with pollen, should be able to get at the nectar, is surely a remarkable specialisation, and also a remarkable confirmation of the result of generalisations I had previously made.

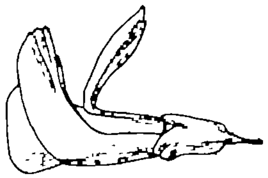


FIG. 2.—Coronilla emerus.

Since then I have examined some other species or varieties of *Coronilla*, viz. *Coronilla emerus*, a very pretty free flowering garden shrub or creeper, a variety of this named *Coronilla emerus lutescens*, *C. montana*, and *C. minima*.

In *Coronilla emerus* the claws of the petals are much prolonged, so as to make the whole flower much longer than in the other species (see Fig. 2). The structure of the staminal tube is like that of Pisum, Lathyrus, Robinia, &c., in having a large cavity at the base filled with water, and large apertures on each side of the base of the tenth stamen, by which the bee's proboscis can reach the nectar. The long tube or channel formed by the claws of the petals is such as to lead the bee's proboscis directly to these apertures; and I have this spring distinctly seen a humble-bee getting the nectar in this way. The aperture between the claws enabled me to see the bee's proboscis going right down to the base of the staminal tube. On the other hand there is no appearance whatever of nectar or of glands containing nectar outside the calyx.

In *C. emerus lutescens* the structure is the same, except that there is a curious little excrescence on the inside of the claw of the vexillum just above the calyx. Does it guide the bee's proboscis to the apertures in the staminal tube, which it is to be remembered are on each side of the central tenth stamen? Mr. F. Darwin has suggested a function of this kind for a somewhat similar structure on the free tenth stamen of Phaseolus.

C. montana is a small plant, very like *C. glauca* in structure. The flower forms compact umbels; the claws of the petals are short, with a wide opening above the calyx; the tenth stamen is free, but the staminal tube is close-fitting, and there is no nectar inside the flower. *Per contra*, there are distinct glands or bubbles of liquid on the outside of the calyx, which is much infested by aphis.

C. minima is similar in structure; and both these species or varieties are similar to *C. glauca*.

We have then in this genus a number of species or varieties, all of which have their tenth stamen free, but which differ widely in other respects.

1. In *C. emerus* and *C. emerus lutescens* the nectar is in the base of the staminal tube, and is accessible by the separation of the tenth stamen in the usual manner.

2. In *C. varia*, *C. montana*, *C. glauca*, and *C. minima* the staminal tube is barren of nectar, but the nectar is secreted outside the calyx, and the access to it is provided for by a special gap between the petals.

In both cases, however, the flower is so constructed that the bee in getting the nectar which he wants dusts himself with and carries from flower to flower the pollen.

Some questions remain. The separation of the tenth stamen and the gap between the petals and the separate stamen both exist in all the species; where one is of use the other is useless. Why do they co-exist? Did one exist before the other? and is one of them now useless and rudimentary? If so which was the earlier and which the later in development?

A further observation arises. These *Coronillas* are foreign plants, and in many gardens and greenhouses have only been introduced recently. In my own garden in Surrey I have introduced *C. varia* and *C. emerus* from London within these last four years, and I am not aware of any other plants in the neighbourhood. But the bees seem quite to understand how to get the nectar from both. In *C. emerus* this is not surprising, for there are many other common flowers—Robinia, Pisum, Vicia, Lathyrus, &c.—similarly constructed. But I know of no flower common in England which is like *C. varia* in having the nectar outside the calyx, with the peculiar access to it through a gap in the petals. And yet the Surrey bee found his way to it at once. Does not this look as if the bee had sufficient intelligence to adapt his doings to a perfectly new and unknown structure?

T. H. FARRER

LENZ'S DOCTRINE OF OCEAN CIRCULATION

A VERY elaborate memoir was presented to the Royal Society at its last meeting, by Mr. Prestwich, containing a digest of all the observations made upon deep-sea temperatures previously to the *Lightning* cruise of 1868, which was the starting-point of all those recent researches that have excited so strong and general an interest. Of these observations, some of the most important were quite unknown to the scientific men of the present day, until brought to light by Mr. Prestwich's patient research; and I would take the earliest opportunity of particularly calling attention to those of Emil Lenz, an eminent German physicist, formerly settled in St. Petersburg,* who accompanied Kotzebue in his second Circumnavigation Voyage in 1823–26. Of this voyage, the obtaining of deep-sea temperatures was one of the special objects; and, with a view to accuracy of observation, experiments were previously instituted by Parrot upon the influence of pressure on self-registering thermometers, of the same kind as those made by Mr. Casella under the late Prof. W. A. Miller and myself in 1869. And the St. Petersburg professors satisfied themselves by their experiments (as we did by ours nearly fifty years later), that any observations taken by sending down ordinary thermometers to great depths must be seriously vitiated by the pressure of the superincumbent water.

Instead of attempting, however, to improve his thermometers by the protecting outer bulb* which made our instruments thoroughly trustworthy, Lenz devised a method of obtaining deep-sea temperatures, which must have been very difficult to work, and which required a good deal of mathematical computation to bring out its results; yet this in his able hands gave temperatures which prove to be in close accordance with the thermometric observations of the *Challenger*. He also made throughout the voyage a careful series of observations on the temperature of the ocean at the surface and at moderate depths below it, which proved to be of the greatest value in the establishment of his general doctrine. And he further made an important series of observations on the salinity of ocean-water as indicated by its specific gravity. The increase of the density of sea-water with the reduction of its temperature down to the freezing-point, was known to Lenz through the experiments of Dr. Marcet in this country, and of Erman in St. Petersburg; and he was consequently free from the influence of the "dominant idea" that the deep water of the ocean, like that of the Swiss lakes, would have the uniform temperature (39¼° F.) of *fresh* water at its greatest density; which obviously influenced the conclusions subsequently drawn from their own observations by D'Urville and Sir James Ross, and led to the general adoption of those conclusions.

The whole series of these observations, with the mathematical computations required for the determination of the real bottom-temperatures, are contained in a most elaborate memoir, entitled "Physikalische Beobachtungen, angestellt auf einer Reise um die Welt, unter dem Commando des Capitains von Kotzebue, in den Jahren 1823-26," presented to the St. Petersburg Academy in 1829, and published in vol. i. of its "Transactions" (1831). No one can examine this memoir without being impressed with the remarkable ability it displays; a peculiarly competent judge, Prof. Debus, whose attention I have directed to it, assures me that it is a model of admirable physico-mathematical investigation.

It was not until 1845, however, that Lenz gave forth the general conclusions to which he was led by his own observations and those of others (so far as known to him) in his admirable "Bemerkungen über die Temperatur des Weltmeeres in verschiedenen Tiefen," published in the "Bulletin" of the St. Petersburg Academy for 1847. He there shows that his own conclusions as to the low temperatures obtained at great depths are not invalidated by the observations of others, indicative of higher temperatures taken with ordinary thermometers; but may still be taken as indicating the presence of glacial water on the bottom of each of the great oceans, even under the equator. And from a discussion of the numerous temperature-observations taken at the surface and at small depths beneath it, Lenz deduces the important conclusion *that there is at and under the equator a belt of water cooler than the water to the north and south of it*. Of this striking phenomenon, he says, the explanation flows directly from the form of the isothermal curve which represents it; and this explanation I shall presently reproduce in his own terms, which will be found singularly accordant with those used by myself in the notice I gave of the *Challenger* observations in the *Athenæum* of May 16.

---

* The list of Lenz's papers occupies four columns of the Royal Society's Catalogue. A large proportion of them consist of original researches, both experimental and mathematical, in electricity and magnetism. And I am assured by Sir Charles Wheatstone that these are of the highest merit, and were greatly esteemed by Gauss and Jacobi, the two great masters in this department of investigation.

* It is right to recall the fact that this "protection" was first devised by Admiral Fitzroy, and was practically worked out by Messrs. Negretti and Zambra, as far back as 1857.

As I have never claimed any originality in regard to the doctrine of oceanic circulation, which I have advocated solely as an important scientific truth, it has afforded me nothing but the most unalloyed satisfaction to find that the doctrine which appeared to me, as to Sir John Herschel (when I brought the case fully before him), the "common sense of the matter," was put forward nearly thirty years ago by one of the most eminent physicists of his day, as a necessary deduction from the facts of observation. That Lenz's Doctrine of Oceanic Circulation (for so it should now be termed) did not then obtain the general acceptance which I now confidently anticipate for it, seems principally due to the little attention formerly paid to Ocean Physics; it being only in recent years that the relation of deep-sea temperatures to the distribution of animal life on the ocean bottom, and the consequent importance of this knowledge in geological research, has made the inquiry one of general interest. This is the point of view in which the study of the subject has been pursued by Mr. Prestwich, whose exhaustive memoir will constitute a most valuable preface to the full discussion of the *Challenger* observations, when these shall have been brought to a conclusion two or three years hence.

"The mass of water in the tropics," says Lenz, "warmed down to a certain depth by the sun's heat, cannot maintain its equilibrium with the colder water of the middle and higher latitudes; a flow of the warmer water from the equator to the poles must necessarily take place on the surface, and this surface-flow must be supplied at the equator by a flow of colder water from high latitudes, which would at first flow in an almost horizontal direction, but which under the equator must rise from below to the surface. In this manner, in the northern hemisphere, a great vertical circulation takes place in the ocean, which has its direction above from the equator to the pole, and below from the pole to the equator. Since these flows, moving in opposite directions, are distinguished by their different temperatures, we observe in the submarine isotherm an indication of the lower portion of this flow. A corresponding flow, but moving in the opposite direction, takes place in the southern hemisphere; so that *in a zone surrounding the equator, where the two flows meet, the water flows almost in the direction from below up to the surface*."

Lenz further adduced the low salinity of the surface-water of the equatorial belt, compared with the high salinity of tropical water, as an additional indication of the continual ascent of polar water from the bottom. And after remarking that water moving in the north and south direction must have its course influenced by the rotation of the earth, he continues, "It is a point which has been determined by Humboldt, John Davy, and others, that the water of the ocean is colder at the surface over shallows, than at some distance beneath over very great depths. This phenomenon, the explanation of which hitherto has not been found to be satisfactory, is a simple consequence of the movement of deep cold water from the pole to the equator. For if this runs against any obstruction, such as a shallow would present, it will rise along it, as upon an inclined plane, and approach nearer the surface, which in this manner will be cooled down." Thus Lenz explicitly propounded the principle on which I have explained the "cold band" between the Gulf Stream and the United States sea-board, the similar cold band on the east coast of Japan, and the cold stratum on the east side of the Dogger Bank. And I venture to believe, therefore, that here, too, the "common sense of the matter" has led me to a right conclusion.

I learn also, from Mr. Prestwich's memoir, that Arago, in 1838, in his instructions for a scientific expedition to Africa, not only distinctly recognised the existence of an underflow of glacial water from the poles towards the equator as the cause of the reduction of oceanic temperature with depth, and explicitly repudiated the doctrine of the uniform deep-sea temperature of 39½°; but also remarked upon the comparatively high temperature of the deeper stratum of the Mediterranean (first ascertained by D'Urville) as indicating that the polar flow does not find its way into that basin through the Strait of Gibraltar; thus anticipating the argument which I have based on my own investigations into the comparative thermal conditions of the Atlantic and the Mediterranean, as to the existence of a polar underflow in the former.

WILLIAM B. CARPENTER

NOTES

WE greatly regret to announce that Prof. Ångström died on the 21st ult.

MR. JOSEPH PRESTWICH, F.R.S., F G S., has been appointed to the office of Professor of Geology in the University of Oxford, as successor to the late Prof. Phillips.

THE Chair of Human Physiology in University College, London, in future to be called the Jodrell Professorship, after the name of its endower, has been filled by the appointment of Dr. J. Burdon Sanderson, F.R.S., who is now Professor of Physiology, including Practical Physiology and Histology. We have reason to believe that Mr. E. A. Schafer will be appointed Assistant Professor under Dr. Sanderson.

M. A. DE CANDOLLE has been elected a Foreign Associate of the French Academy in the place of the late Prof. Agassiz

THE death, at the early age of 28, is announced of Mr. Charles Tyrwhitt Drake, one of the officers in charge of the survey of Palestine. He succumbed to a second attack of malarious fever.

ENTOMOLOGISTS generally, and Coleopterists in particular, have experienced a great loss in the death of Mr. George Robert Crotch, M.A., of St. John's College, Cambridge. Mr. Crotch graduated in 1863, obtaining honours in the Natural Science Tripos. Until 1872 he was one of the Under Librarians at the University Library, when, besides his excellent work in that Institution, he devoted his spare time to his favourite subject. Mr. Crotch sailed for America in 1872, *en route* for Australia, for the purpose of studying the entomology of parts which he considered incompletely known, and on several occasions he has transmitted collections to England. He had added considerably to our knowledge of the entomology of California, Vancouver's Island, Oregon, and other districts; and on two occasions the Senate of Cambridge, recognising the importance of his work, voted him a sum of money from the University chest to aid him in sending collections to the University Museum.

TWO scientific expeditions are to set out from Archangel next summer—one into Russian Lapland, for the purpose of exploring the traces of ancient glaciers; the other, to the shores of the White Sea, has for its object zoological investigations. Dr. Yarjinsky, *La Revue Scientifique* states, who explored the district two years ago, discovered in the White Sea and the glacial ocean fishes and crustaceans till then quite unknown.

MR. JAMES LICK, of San Francisco, California, having in the course of his life accumulated a large fortune, has recently concluded a deed by which he conveys all his property to seven persons upon trust to be applied to various worthy objects. Among these, 700,000 dols. are to be applied to the construction of a more powerful telescope than any yet made, to be erected at an observatory in California, and 300,000 dols. to found, in California, a school of the mechanical arts.

The last but one of the Government expeditions for observing the transit of Venus sailed from Plymouth for Christchurch, New Zealand, in the clipper ship *Merope*, on Saturday. The party consists of Major H. S. Palmer, R.E., chief astronomer in charge; Lieut. L. Darwin, R.E., assistant-astronomer and photographer; Lieut. H. Crawford, R.N., assistant-astronomer, and three non-commissioned officers of the Royal Engineers trained in the use of the photoheliograph.

A Correspondent writes that he has tried, with almost complete success, Prof. Helmholtz's remedy for Hay Fever, referred to in the paper (Nature, vol. x. p. 26) sent us by Prof. Tyndall. Our correspondent gives the details of his treatment in a letter to the *Manchester Examiner* of the 30th ult., which also contains a letter from another sufferer who has tried Helmholtz's remedy with success. Our correspondent also asks,—"Could any of your readers give any information as to Weber's nose douche?—a more effective method of administering the remedy than by means of the pipette is desirable."

Mr. Saville Kent, Curator of the Manchester Aquarium, seems resolved to do his best to make that institution subserve the purposes of scientific instruction. Last Friday he gave the first of a series of lectures on subjects connected with aquaria to a fairly numerous audience; it is intended, we believe to continue the lectures on Friday afternoons during the summer.

Dr. John Kirk has received a letter from Lieut. Cameron dated Ujiji, Feb. 25, reporting his safe arrival at that place; he was just about to start for Unyanyembe. He heard from the people of Ujiji that the Lualaba from Nyangwé goes into the Mwootawzige or Bahari Unyoro, "so that," he says, "it must be the Nile after all."

Mr. Forsyth, the leader of the Yarkund Mission, arrived at Leh on the 17th. ult. He is expected in Calcutta about the 15th inst. Dr. Stoliczka is reported to have died on the 19th ult. at Shyok, above the Saser Pass.

The prospectus is issued of a series of Positivist publications, *La Bibliothèque Positiviste*, to be written by M. André Poey, having for its object the popularisation of the positive philosophy. The prospectus is mainly an eloquent eulogy of the Positivist doctrines, and an attempt to show that since Comte began to write they have gradually penetrated everywhere. The *Bibliothèque Positiviste* will consist of 30 monographs, to be published at intervals, in which the principles of Positivism will be expounded in relation to every sphere of human thought and action. The first part is entitled "La Bibliographie Positiviste," and will contain a list of 750 publications in favour of or opposed to Positivism, all of which have been published since Comte began to write. The publisher is Ernest Leroux of Paris.

The Turners' Company, unlike most of the antiquated City guilds, seems to be alive to the fact that there are other kinds of merit worthy of honour besides the distinguished one of being a prince of the blood, a foreign potentate, a conquering hero, or one of her Majesty's ministers. It requires distinction of a very blazing kind indeed to attract the attention of most of our obtuse City Companies. The above Company is, however, a creditable exception in this respect to most of the others. Shortly before his death it conferred its freedom upon the late Prof. Phillips, and last week it did itself the honour of marking in a similar way its appreciation of the work which has been done by Sir Charles Lyell, Bart., F.R.S. The Turners' Company is evidently awake to the fact that after all the Useful Arts, Manufacture, and Commerce may derive some benefit from the results of non-utilitarian scientific research. The arts represented by the Turners' Company use, as part of their material, various sorts of stones, and Mr. Jones, the Master, showed in his really eloquent and well-informed address last week, that these arts have been greatly indebted to Sir Charles Lyell for having done much in their behalf by spreading a knowledge of the materials with which they work. Sir Charles, in his reply, spoke of the storm of opposition raised against many of the geological doctrines propounded in his first work, half a century ago, as compared with their almost universal acceptance at the present day.

We have received a copy of a very able address delivered by Dr. Julius Haast, F.R.S., before the Philosophical Institute of Canterbury, New Zealand, in which he comments on several points connected with the geology of that country, maintaining his own theory as to the glacial origin of the Canterbury Plains in opposition to that of their marine formation, as supported by Capt. Hutton. In speaking of the extinct Struthious birds whose remains are so abundant, he is disposed to divide them, contrary to Prof. Owen, into two main families: the Dinornithidæ with a long metatarsus, no hallux, and a bony scapulo-coracoid bone; and the Palapterygidæ with a short metatarsus, with a fully-developed hallux, and no ossified scapulo-coracoid bone; the last-named character being one of particular interest, and supported by several arguments, the strongest of which depends on the absence of any coracoid articular grooves on the anterior margin of the sternum.

A rather strong shock of earthquake was felt at Constantinople on Friday, lasting two seconds. No accident is reported.

The French Government has recently voted the sum necessary for the formation of a great inland sea in Algeria, 190 miles long by 36 broad, to the south of Biskra. A chain of chotts (*Chott* implying the bed of a lagoon) considerably below the level of the Mediterranean, is to be utilised for the purpose. A full account of the project is given in the first June number of the *Revue des Deux Mondes*.

The meeting which was to have been held this month in London in connection with the Edinburgh University Buildings Extension Fund, has been postponed until November next.

Mr. Sanderson, from Lancing College, has been elected to a Natural Science Scholarship in Worcester College, Oxford. Messrs. Hugh Brocas-Price, from University College, London, and Mr. Henry H. Robinson, from Magdalen College School, have been elected to Natural Science Demyships in Magdalen College.

Mr. W. J. Noble, of Epsom College, has been elected to a Natural Science Scholarship in Keble College, Oxford.

A means of preventing the spread of the vine-pest, the *Phylloxera vastatrix*, is said to have been found, in the spreading of a layer of fine sand on the ground round the stems of the plants. The sand is said to be too loose for this insect to pass through, and the consequence is that it is intercepted in its passage from one plant to another. We are sorry to hear a report that this plague has found its way into Australia. The vine-growing districts of our Australian colonies are becoming so important that we trust this report may be unfounded. At all event steps should be taken to prevent its introduction into any of our colonies: such a measure will be easier than its destruction, should it ever gain a footing in them.

In view of the scarcity and high price of oysters in this country it is alarming to hear that the celebrated beds of Arcachon, Concarneau, and other places in the west of France, are thought to be less productive than formerly. The want of accurate knowledge concerning this bivalve is probably at the root of this scarcity, and it may also be possible that the changes which are constantly taking place in the position and even in the nature of the sea-coast, may have a serious effect on the productiveness of the oyster beds all over the world. It is a well-known fact that oysters will not grow in certain localities where the conditions are apparently exactly similar to other localities where they will thrive; and the gradual change wrought by the sea in certain parts of the coast may account, quite as much as overfishing, for the gradual extinction of oysters. All beds are, however, fished much more extensively now than they were a few years ago, and whenever one is discovered, it is quickly worked out, without any consideration being given to the question of its extent, and whether it is a newly-established bed or not. America now largely supplies us with oysters either in a fresh state or preserved in tins, and it is calculated that in Maryland State alone, 5,282 persons are employed in dredging, and 10,947,803 bushels of oysters were taken in 1870-71; while the waters of Virginia are said to be equally productive. In the great oyster markets of Baltimore, where immense quantities of oysters are tinned, over 10,000 hands are employed in this branch of the trade.

A VALUABLE contribution to zoology is furnished by a paper published by Mr. Dall, on the birds of the Aleutian Islands, especially of that portion of the region to the west of Oonalaska, embracing the result of observations made during 1873 on board the U.S. Coast Survey vessel, the *Yukon*. As might have been expected, the great majority of the species are water-birds, particularly *alcadæ*, upon the natural history of which Mr. Dall throws much light, having been the first to collect eggs of several of the species, and observe their habits during the breeding season. The land-birds on this island are very few in number, consisting of two kinds of hawks, one owl, a swallow, and a wren, five finches, the raven, and ptarmigan. The total number of species enumerated is forty-five.

WE have received the prospectus of a work entitled "The Dominion of Canada; comprehending a General Description of the Confederated Provinces of British North America, and the North-west Territories," by Henry Youle Hind, M.A. (Montreal: John Lovell.) The following are the leading subjects.—I. Physical Geography of the Dominion. II. Climate and Climatic Effects. III. Geological Features. IV. Travel and Transportation. V. Agricultural, Forest and Mining Industries. VI. Commerce, Manufactures, and Fisheries. VII. The Inhabitants. VIII. Government. IX. Social Status. X. Miscellanea. The illustrations will consist of upwards of 250 engravings on steel, chromoxylographs, woodcuts, &c.

AT present the principal source of income to the United States from its acquisition of Alaska, and that which pays the larger part of the interest on the original investment of 7,000,000 dols. in its purchase, is derived from the fur-seal islands of St. Paul and St. George, which constitute the Pribylov group, in the Behring Sea. It is from these islands that the greater number of the skins of the fur seal as known in commerce are derived, the animals resorting to them in immense numbers every spring for the purpose of bringing forth their young. In 1870, an Act was passed by Congress limiting the number to be killed at 100,000. The Alaska Commercial Company secured the lease of the fishery, and has carried out the contract in apparent good faith. The condition of the islanders has been considerably improved Congress has authorised the appointment of a commission to investigate the natural history and geographical distribution of the fur seal.

FROM the *Monthly Notices* of the Royal Society of Tasmania for June, July, and August, 1873, we learn that the Society has been making an inquiry in reference to the stone implements of the Tasmanian aborigines, especially as to whether the natives made use of these implements fastened to handles, after the manner of axes or tomahawks. All inquiries on the subject tend to prove that no true tomahawks were known to or fabricated by the natives; they merely used sharp-edged stones as knives. These were made sharp, not by grinding or polishing, but by striking off flakes with another stone till the required edge was obtained. As a very general, if not invariable, rule, one surface only was chipped in the process of sharpening. They were made from two different kinds of stone—the one apparently an indurated clay rock, the other containing a large proportion of silex.

A WRITER in the *Times* complaining of the want of labels in the Bird Gallery of the British Museum, states that "A young and active Naturalist has been appointed specially to look after this part of the collections." It is hoped that he will see that all the specimens are furnished with labels.

SOME experiments of particular interest physiologically have been undertaken by Dr. Worm Muller, and are described by him in Ludwig's *Arbeiten* (vol. viii. p. 159), an abstract of which paper will be found in the *London Medical Record* for last week. The author finds that the transfusion into the circulatory system of an amount of blood three times as much as that normally contained in the system does not cause any rise in the arterial blood pressure, though the pulse-rate is reduced. The reduction of the quantity of blood after transfusion, however, causes a rapid fall in the blood-pressure, even when only half that added has been removed. We think that the former of these results is not difficult to explain, for the heart, being an engine with only a limited capacity for work, it can only maintain a certain determinable blood-pressure, depending on the bulk of its muscular parietes. The introduction of an excess of blood to be circulated can therefore act only in filling the system at the expense of the velocity of the current, with a diminution in the rapidity of the cardiac action.

IT may be of some interest with reference to the demand of ladies to be admitted to the ordinary degrees of the University of London, to note that at the recent distribution of prizes at University College the first and second places in the mixed class of Jurisprudence were both occupied by ladies, Miss E. Orme, who two years ago took the prize in the class of Political Economy, coming out first, while in the mixed class of Political Economy a lady this year took the fourth certificate.

DR. W. G. FARLOW has published in the *American Journal of Science and Arts* an account of some investigations carried on in the botanical laboratory of the University of Strasburg, illustrating a remarkable asexual development from the prothallus of *Pteris serrulata*. In the centre of the cushion or thickest part of the prothallus were a number of scalariform ducts, the prothallus bearing a number of antheridia, but no archegonia. From these ducts a leaf is developed directly, after which a root is also developed, and last of all a stem-bud. A comparison was drawn between this growth, which was observed in this species only, and the buds produced in the ordinary way from the protonema of a moss. Normally the prothallus of a fern is entirely destitute of vascular tissue of any kind.

DR. McKendrick (*Brit. Med. Journ.*, June 27, 1874) has made a contribution to the subject of the physiological antagonism of medicines which has been so elaborately illustrated by the works of Fraser and Crum Brown. He finds that while Bromal causes an excessively copious secretion of saliva, Atropine quickly arrests it, in rabbits Possible practical applications of this discovery in the treatment of various kinds of ptyalism in man are at once thought of, and already cases of so-called success in the salivation of pregnancy are recorded.

IN the Bulletin of the Buffalo Soc. Nat. Sci. No 4, vol. I., will be found a paper by Prof. Hartt on the geology of the Lower Amazons. He determines, on palæontological evidence, that the great plain of the Serra of Ereré is of Devonian age.

AMONG recent additions to the Manchester Aquarium are the following :—1 Smooth Hound or Skate-Toothed Shark (*Mustelus vulgaris*) ; 2 Topers or White Hound (*Galeus canis*) ; 2 Picked Dog-fish (*Acanthias vulgaris*) ; 4 Lesser Spotted Dog-fish (*Scyllium canicula*) ; 4 Greenland Bullheads (*Cottus grœnlandicus*) ; 3 Gemmeous Dragonets (*Callionymus lyra*) ; 5 Cat or Wolf-fish (*Anarhicas lupus*) ; 2 Tadpole Fish (*Raniceps trifurcus*) ; Zoophytes—*Actinoloba dianthus, Sagartia bellis, S. nivea, S. viduata, S. miniata, Tealia crassicornis.*

THE additions to the Zoological Society's Gardens during the past week include a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Captain Webster ; two Rhesus Monkeys (*Macacus erythræus*) from India, presented by Mr. W. Dunn ; a Chinese Turtle Dove (*Turtur chinensis*), from India, presented by Major F. Gildea ; a Canadian Beaver (*Castor canadensis*) and a Virginian Deer (*Cervus virginianus*), born in the Gardens ; a Lanner Falcon (*Falco lanarius*), from east Europe, purchased.

SCIENTIFIC SERIALS

Transactions of the Norfolk and Norwich Naturalists' Society, 1873-74 (Norwich : Fletcher & Son).—This Society is now in the fifth year of its existence, and is in a satisfactory condition as to members. The chief features of the present number of its "Transactions" are Parts IV. and V. of the "Fauna and Flora of Norfolk," which the Society has undertaken to publish. Part IV., by Dr. John Lowe, embraces a list of the fishes known to occur in the Norfolk waters ; and Part V. (forming a separate supplement), the Norfolk Lepidoptera, by Mr. C. G. Barrett. Both lists appear to have been done with great care and caution, and we should think that Dr. Lowe and Mr. Barrett have left very little to be added. The catalogues reflect the greatest credit both upon the compilers and on the Society, a few of the wealthier members of which have contributed the greater part of the expense of printing the present supplement. The next instalment of this important work of the Norfolk Society will contain the flowering plants, by Mr. H. D. Geldart. The president's address gives a *résumé* of the year's work of the Society, and discusses the question of Biogenesis.—Mr. F. D. Wheeler contributes a paper On breeding Lepidoptera in confinement, giving the results of the author's own experience ; and Mr. F. Kitton one On Empusca and other micro-fungi.—In a short paper by Mr. J. B. Bridgman On the nidification of the Prosopis, the author concludes that this bee forms its "nest in any suitable situation, whether in soft earth or wood, not even despising ready-formed holes, and that it collects and carries home pollen in its mouth, after working it up in a pellet."—Mr. John Quinton contributes notes On the meteorological observations recorded at Norwich during the years 1870 73.—A variety of interesting miscellaneous natural history notes conclude the number. Altogether this Society must be congratulated on its year's work ; its first object is "the practical study of natural science," which it seems to be carrying out with considerable faithfulness.

Proceedings of the Bath Natural History and Antiquarian Field Club, vol. iii. No. 1. 1874. This Society, to judge from this number of its "Proceedings," seems to devote itself mainly to antiquarian research, "Natural History," though it comes first in its title, seeming to find but small favour among the members. This defect the secretary animadverts strongly upon in his "Summary of Proceedings," stating, moreover, that the club was originally started for the purpose of botanical research. We do not undervalue antiquarian research, but we think it a pity that a club containing so many intelligent and well-educated members should fritter away almost its entire time and strength in a department that could be very satisfactorily worked by a small proportion of its members, to the almost entire neglect of the rich field presented by the district around Bath for Natural History investigation. We hope that the next number of its Proceedings will show that the suggestions of the secretary have been adopted. The only two natural history papers in this number are by Mr. C. E. Broome, F.L.S., On some of the fungi found in the Bath district, the present paper including Order 10, Myxogasters, and a short note by the Rev. Leonard Blomefield, F.L.S., On the occurrence of the Land Planaria (*Planaria terrestris*) in the neighbourhood of Bath. Dr. Bird was the first to discover this animal (supposed to be the only species of Land Planaria in western Europe) in the Bath district, and Mr. Blomefield is inclined to believe it to be carnivorous, making a prey of the smaller land molluscs. The secretary gives an extremely interesting summary of the meetings and excursions of the Society during 1873-74.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, June 1.—The observations of M. Marié Davy on the diminution of certain river waters in France are here closed with a discussion on the influence of different kinds of vegetation growing in their basins. It is shown that waste open land evaporates the least amount of rain-water, and forests less than corn or other farm produce. The increase of high farming and artificial meadow-land, absorbing and evaporating much moisture, must diminish the size of streams by robbing them of part of their supply, and to keep up the summer flow of a river it might be thought desirable to plant its upper basin with forests. Comparison of different rivers shows, however, that no valuable addition would thus be gained. Whatever be the origin of the river, geological conditions are alone effective. Therefore, although as a measure of national economy, for fixing soil on slopes, mitigating floods and changes of level, and providing cheap fuel, the maintenance of forests would be beneficial, we must look forward to a time when the art of storing some of the excess of winter rainfall to supply the needs of summer will be adopted in agriculture.—Among the "Kleinere Mittheilungen," Prof. Prestel deduces from twenty years' measurement of ozone a result similar to that of Herr Karlinski at Krakau, showing a minimum in November or December and a maximum in the spring.—The work of Herr Edlund on the mean temperature of Sweden, and a delicate form of Goldschmidt's aneroid, are here noticed.

Schriften der Naturforschenden Gesellschaft in Danzig, 1873.—The history of the population in the eastern provinces of Prussia is still involved in much obscurity, while that of the remaining provinces is pretty accurately known. In one of the papers in this volume Dr. Marshall considers the evidence obtainable from early writers—Pliny, Tacitus, &c.—from names of persons and places, and more especially from the archæological collections, of which there are two, imperfectly arranged, in Konigsberg. From a study of grave-relics, Dr. Marshall is led to the conclusion that, at one time, in these eastern provinces two distinct races lived together. Several races having come from the east and settled in the coast-lands of the Baltic, more than 1,000 years B.C., this land was, later, overrun by Goths from central Russia, many of whom pressed on to Scandinavia and the Danish Islands, and to western and southern Europe ; but a number remained on the amber coast, especially in the Weichsel region, and became fused with the Aestian or Wend race, already there ; they were together known as *Prussen*.—Among the papers is another giving an account of a chemical analysis (made by direction of Dr. Friederici) of certain empty grave-urns of the ancient Prussians, the significance of which has not been clearly ascertained. Dr. Friederici thinks they were in themselves sacred vessels ; they are made not from clay, but from ashes, firmed probably with blood of animals killed in sacrifice. In heating, the blood and the carbon particles at the surface had been turned to ashes, presenting a reddish-yellow appearance, while the internal substance was merely carbonised, and darker in colour.—Dr. Lissauer gives an account (with excellent photographs) of some more of those curious face-urns that have been found in large numbers in certain parts of Pomerania ; and M Kasioki describes a number of antiquities of various kinds discovered in Pomerania during 1872.—Dr. Lebert, who has been experimenting on the fluorescence of some specimens of Sicilian amber, finds the phenomenon in these much more marked and frequent than in Prussian amber ; in the case of the latter he has observed, with strong sunlight, not only the existence, but the manifold character of the cone of light.—A valuable paper on new and extended employment of the level for astronomical and geodetic measurements is contributed by M. Kayser, and M. Menge continues a list and description of Prussian spiders.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—On the Force caused by Evaporation from and Condensation at a Surface, by Prof. Osborne Reynolds, of Owens College, Manchester.

It has been noticed by several philosophers, and particularly by Mr. Crookes, that, under certain circumstances, hot bodies appear to repel and cold ones to attract other bodies. It is my object in this paper to point out and to describe experiments to prove that these effects are the results of evaporation and condensation; and that they are valuable as evidence of the truth of the kinetic theory of gas, viz. that gas consists of separate molecules moving at great velocities.

The experiments of which the explanation will be given were as follows:—

A light stem of glass, with pith-balls on its ends, was suspended by a silk thread in a glass flask, so that the balls were nearly at the same level. Some water was then put in the flask and boiled until all the air was driven out of the flask, which was then corked and allowed to cool. When cold there was a partial vacuum in it, the gauge showing from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch pressure.

It was now found that when the flame of a lamp was brought near to the flask the pith-ball which was nearest the flame was driven away; and that with a piece of ice the pith was attracted.

This experiment was repeated under a variety of circumstances, in different flasks and with different balances, the stem being sometimes of glass and sometimes of platinum; the results, however, were the same in all cases, except such variations as I am about to describe.

The pith-balls were more sensitive to the heat and cold when the flask was cold and the tension within it low, but the effect was perceptible until the gauge showed about an inch, and even after that the ice would attract the ball.

The reason why the repulsion from heat was not apparent at greater tensions was clearly due to the convection currents which the heat generated within the flask. When there was enough vapour, these currents carried the pith with them; they were, in fact, then sufficient to overcome the forces which otherwise moved the pith. This was shown by the fact that when the bar was not quite level, so that one ball was higher than the other, the currents affected them in different degrees; also that a different effect could be produced by raising or lowering the position of the flame.

The condition of the pith also perceptibly affected the sensitiveness of the balls. When a piece of ice was placed against the side of the glass, the nearest of the pith-balls would be drawn towards the ice, and would eventually stop opposite to it. If allowed to remain in this condition for some time, the vapour would condense on the ball near the ice, while the other ball would become dry (this would be seen to be the case, and was also shown by the tipping of the balance, that ball against the ice gradually getting lower). It was then found when the ice was removed that the dry ball was insensible to the heat, or nearly so, while that ball which had been opposite to the ice was more than ordinarily sensitive.

If the flask were dry and the tension of the vapour reduced with the pump until the gauge showed $\frac{1}{2}$ of an inch, then, although purely steam, the vapour was not in a saturated condition, and the pith-balls which were dry were no longer sensitive to the lamp, although they would still approach the ice.

From these two last facts it appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat.

In order that these results might be obtained it was necessary that the vapour should be free from air. If a small quantity of air was present, although not enough to appear in the gauge, the effects rapidly diminished, particularly that of the ice, until the convection currents had it all their own way. This agrees with the fact that the presence of a small quantity of air in steam greatly retards condensation and even evaporation.

With a dry flask and an air-vacuum, neither the lamp nor the ice produced their effects; the convection currents reigned supreme, even when the gauge was as low as $\frac{1}{4}$ inch. Under these circumstances the lamp generally attracted the balls and the ice repelled them, *i.e.* the currents carried them towards the lamp and from the ice; but by placing the lamp or ice very low the reverse effects could be obtained, which goes to prove that they were the effects of the currents of air.

These experiments appear to show that evaporation from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward. These effects admit of explanation, although not quite as simply as may at first sight appear.

Although there must always be reaction corresponding to the visible motion, whenever vapour is driven off from a surface, this visible motion is too small to account for the forces under consideration. But, although it appears to have escaped notice so far, it follows as a direct consequence of the *kinetic* theory of gases that whenever evaporation takes place from the surface of a solid body or a liquid, it must be attended with a reactionary force equivalent to an increase of pressure on the surface, which force is quite independent of the perceptible motion of the vapour. Also condensation must be attended with a force equivalent to a diminution of the gaseous pressure over the condensing surface, and likewise independent of the visible motion of the vapour. This may be shown to be the case as follows:—

According to the kinetic theory the molecules which constitute the gas are in rapid motion, and the pressure which the gas exerts against the bounding surfaces is due to the successive impulses of these molecules, whose course directs them against the surface, from which they rebound with unimpaired velocity. According to this theory, therefore, whenever a molecule of liquid leaves the surface henceforth to become a molecule of gas, it must leave it with a velocity equal to that with which the other particles of gas rebound—that is to say, instead of being just detached and quietly passing off into the gas, it must be shot off with a velocity greater than that of a cannon-ball. Whatever may be the nature of the forces which give it the velocity, and which consumes the latent heat in doing so, it is certain, from the principle of conservation of momentum, that they must react on the surface with a force equal to that exerted on the molecule, just as in a gun the pressure of the powder on the breech is the same as on the shot.

The impulse on the surface, from each molecule which is driven off by evaporation, must therefore be equal to that caused by the rebound of one of the reflected molecules (supposing all the molecules to be of the same size), that is to say, since the force of rebound will be equal to that of stopping the impulse from a particle driven off by evaporation will be half the impulse received from the stopping and reflection of a particle of the gas. Thus the effect of evaporation will be to increase the number of impulses on the surface; and, although each of the new impulses will only be half as effective as the ordinary ones, they will add to the pressure.

In the same way, whenever a molecule of gas comes up to a surface and instead of rebounding is caught and retained by the surface, and is thus condensed into a molecule of liquid, the impulse which it will thus impart to the surface will only be one-half as great as if it had rebounded. Hence condensation will reduce the magnitude of some of the impulses, and hence will reduce the pressure on the condensing surface.

This explanation is then put in a mathematical form, and the paper proceeds.

Applying these results to steam, we find that at a temperature of 60° the evaporation of 1 lb. of water from a surface would be sufficient to maintain a force of 65 lbs. for one second.

It is also important to notice that this force will be proportional to the square root of the absolute temperature, and consequently will be approximately constant between temperatures of 32° and 212°.

If we take mercury instead of water, we find that the force is only 6 lbs. instead of 65; but the latent heat of mercury is only $\frac{1}{33}$ that of water, so that the same expenditure of heat would maintain nearly three times as great a force.

It seems, therefore, that in this way we can give a satisfactory explanation of the experiments previously described. When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp, therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near the temperature of the pith it will be reduced, and it will condense the vapour and be drawn towards the ice.

The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum was because he had then too large a proportion of air or non-condensing gas mixed with the vapour, which also was not in a state of saturation. In the experiments the condensable vapour was that of mercury, or something which required a still higher temperature, and it was necessary that the vacuum should be very perfect for such vapour to be anything like pure and in a saturated condition. As soon, however, as this state of perfection was reached, then the effects were more apparent than in the corresponding case of water. This agrees well with the explanation; for, as previously shown, the effect of mercury would for the same quantity of heat be three times as great as that of water; and besides this, the perfect state of the vacuum would allow the pith (or whatever the ball might be) to move much more freely than when in the vapour of water at a considerable tension.

Of course the reasoning is not confined to mercury and water; any gas which is condensed or absorbed by the balls when cold in greater quantities than when warm would give the same results; and as this property appears to belong to all gases, it is only a question of bringing the vacuum to the right degree of tension.

There was one fact connected with Mr. Crookes' experiments which, independently of the previous considerations, leads me to the conclusion that the result was due to the heating of the pith, and was not a direct result of the radiated heat.

In one of the experiments exhibited at the Soirée of the Royal Society, a candle was placed close to a flask containing a bar of pith suspended from the middle; at first the only thing to notice was that the pith was oscillating considerably under the action of the candle; each end of the bar alternately approached and receded, showing that the candle exercised an influence similar to that which might have been exercised by the torsion of the thread had this been stiff. After a few minutes observation, however, it became evident that the oscillations continued instead of gradually diminishing, as one naturally expected them to do; and, more than this, they actually increased, until one end of the bar passed the light, after which it seemed quieter for a little, though the oscillations again increased until it again passed the light.

The explanation given is that, owing to the slowness with which the pith takes in and gives out heat, its ends will on the whole be hotter while receding from than while approaching the candle, and hence the force, as a mean, will be greater on that end which is receding, and there will be a continual oscillation.

Since writing the above paper, it has occurred to me that, according to the kinetic theory, a somewhat similar effect to that of evaporation must result whenever heat is communicated from a hot surface to gas.

The particles which impinge on the surface will rebound with a greater velocity than that which they approached, and consequently the effect of the blow must be greater than it would have been had the surface been of the same temperature as the gas.

And in the same way whenever heat is communicated from a gas to a surface the force on the surface will be less than it otherwise would be, for the particles will rebound with a less velocity than that at which they approach.

It is then shown mathematically, that for every English unit of heat communicated to steam at a temperature of 60°, the reaction on the surface is equivalent to ·38 lb. acting for one second; and in the same way for air the force is equivalent to ·55 lb. It is also pointed out that since the diffusion of heat within a gas is inversely proportional to its density, the amount of heat communicated from a surface to the surrounding gas is independent of the density of the gas, and hence, that the reaction on the pith in Mr. Crookes' experiments would remain constant as the vacuum improved, while the counteracting forces would diminish and leave the balls more free to move. It is therefore assumed that the results obtained in those experiments might have been at least in part due to such forces.

Linnean Society, June 19.—Dr. G. J. Allman, F.R.S., president, in the chair.—Mr. D. Hanbury, treasurer, exhibited branches of olive grown in the open air at Clapham, some bearing flowers, others nearly ripe fruit; also a specimen of *Rheum officinale* Baill., now grown in this country for the first time, the source of the true medicinal Turkey rhubarb, and pointed out the characters in which it differs from other species of the genus.—Dr. Hooker made a communication on the subject of some India *Garcinias* to the effect:—(1) That the *G. indica* Chois. (*purpurea* Roxb.), had been placed in a wrong section in Anderson's review of the genus in the "Flora of British India." (2) That the plant described in the same work as *G. griffithii* is proved to be the true Gamboge plant of Siam, *G. pinella*, var. *pedicellata* of Hanley, which Dr. Hooker regards as a distinct species, and proposes that the name of *G. hanburyi* should be given to it. (3) That the *G. brevirostris* of Scheffer is identical with *G. eugeniæfolia* of Wallich. (4) That the name of *G. ovalifolia* Hook. f., must give place to the previously published *G. ovalifolia* of Oliver's "Flora of Tropical Africa;" and the Indian plant must take the name of *spicata*, it being a form of *Xanthochymus spicatus* W. et A.—Prof. Thiselton Dyer exhibited a young oak-plant with three cotyledons, which had been sent to him by Mr. Cross, of Chester; also a pitcher-like development of a leaf of the common cabbage, from Harting, Sussex, sent by Mr. H. C. Watson to the Kew Museum.—Mr. A. W. Bennett exhibited drawings of the style, stigma, and pollen-grain of *Pringlea antiscorbutica* Hook. f., describing the remarkable manner in which the pollen of *Pringlea* differs from that of other nearly allied Cruciferæ, being much smaller and perfectly spherical, instead of elliptical with three furrows. This he considered a striking confirmation of Dr. Hooker's suggestion that we have here a wind-fertilised species of a family ordinarily self-fertilised, a hypothesis which is again confirmed by the total absence of hairs on the style of *Pringlea*.—An extract was read of a letter from Mr. Harry Bolus to Dr. Hooker, F.R.S., dated Graaf Reinet, April 4, 1874, in which he comments adversely on some of the reasonings contained in Grisebach's "Vegetation der Erde" in favour of the theory of "independent centres of creation." Grisebach, relying chiefly on an observation of Burchell's, makes the Orange river the boundary between the Cape and Kalahari provinces, a boundary which Mr. Bolus shows to be untenable, at least in certain portions. Grisebach unites the Kanoo flora with that of the Cape province; while Mr. Bolus doubts whether it does not differ more from this than from the Kalahari. The Roggeveld, and indeed the whole Kanoo, by its predominance of shrubby Compositæ, seems to incline more to the desert type of plants than to the richer Cape flora.—The following papers were then read, viz.:—On the resemblances between the bones of typical living reptiles and the bones of other animals, by Harry G. Seeley.—On the Auxemmeæ, a new tribe of Cordiaceæ, by J. Miers.—A revision of the sub-order Mimoseæ, by G. Bentham, LL.D.—On some fungi collected by Dr. S. Kurz in Yomah, Pegu, by F. Currey.—Notes on the letters from Danish and Norwegian naturalists contained in the Linnean correspondence, by Prof. J. C. Schiodte, of Copenhagen.

Geological Society, June 10.—John Evans, F.R.S., president, in the chair.—The following communications were read:—On the occurrence of Thanet-beds and a crag at Sudbury, Suffolk, by William Whitaker. After referring to some passages in papers by Mr. Prestwich, in which the probable existence of Thanet-beds in North Essex is mentioned, the author described certain sections near Balingdon, on the right bank of the Stour, which exhibit sands belonging to this series. The crag-beds described by the author are found on the left bank of the Stour, in Suffolk, and consist of ferruginous dark reddish-brown sand, with layers of ironstone, slightly false-bedded, with here and there light-coloured grit with broken shells.—Notes on the phenomena of the Quaternary Period in the Isle of Portland and around Weymouth, by Joseph Prestwich, F.R.S. Commencing with the oldest drift-beds, the author showed that the remains of one, formerly more extensive, had been found in the Isle of Portland at a height of 400 ft. above the sea; that it contained the remains of the *Elephas antiquus*, *Equus fossilis*, &c.; and that he found in this bed a number of pebbles of sandstone and ironstone of Tertiary age, and of chert from the Greensands, whence he inferred that, as such pebbles could not now pass over the plain of Weymouth, they must have done so before that area was denuded, and when bridged over by the Portland and Purbeck beds; for the pebbles are derived from beds which are only *in situ* to the north of the Weymouth district, and at a distance of eight to ten miles from Portland. Further, this transport must have taken place before the elevation of the north end of Portland, and when the slope from the Bill to the Ridgeway was uniform and gradual. The anticlinal line, which has elevated the intermediate area, must be of later date than the drift-bed. The author next proceeded to notice the raised beach at the Bill of Portland, in which he had, with the assistance of Mr. Jeffreys, determined twenty-six species of shells, two of them not now living in the British Channel, and one new. This beach contains pebbles of the Devonshire and Cornwall rocks. The raised beach Mr. Prestwich found to abut against an old cliff that had been swamped at a later geological period by a land-wash, which had levelled it and the old sea-land with the adjacent land-surface. The mass which had thus swamped the cliff and buried the beach consisted of loam and angular *débris*, the latter being in larger proportion at top. In the loam he found several species of land and fresh-water shells and fragments of bones. The angular *débris* consisted of pieces of the local rocks, together with a number of specimens, which by their organic remains were shown to belong to the Middle Purbecks, a part of the series not now existing in Portland. A similar bed, but much thicker, was then described at Chesilton, in the north of the island. It is there 60 ft. thick, and contains large blocks of Portland stone and Portland chert, the greater number of which are in the upper part of the deposit, which is here on the sea-level, and 400 ft. lower than the Portland escarpment which rises above it. This loam and angular *débris* the author was disposed to attribute to a temporary submergence of the land to a depth exceeding the height of Portland, and by which the land as it emerged was swept, and its *débris* carried down to the lowest levels, with the remains of its land-animals and land and fresh-water shells, which latter, where protected by large masses of loam and suddenly entombed, have been preserved uninjured. To this deposit, which is common over the raised beaches on the south coast, the author proposed to apply the term "land-wash." The paper concluded with a short notice of the drift-beds formed subsequently to the denudation of the Weymouth district, and therefore never on the high-level Portland drift.—On the character of the diamantiferous rock of South Africa, by Prof. N. Story Maskelyne, F.R.S., Keeper, and Dr. Flight, Assistant, of the Mineralogical Department, British Museum. In this paper the authors confirmed certain statements made by one of them from a superficial examination of specimens brought to this country by Mr. Dunn. The specimens examined and analysed by Dr. Flight were obtained from various diggings and from different depths, down to 180 ft. in the case of one mass from Colesberg Kopje. Their characters throughout are essentially the same. The rock consists of a soft and somewhat pulverulent ground-mass, composed of a mineral (soapy to the touch) of a light yellowish colour in the upper, and of an olive-green to bluish-grey colour in the lower parts of the excavations. Interspersed in the mass are fragments of more or less altered shale, and a micaceous-looking mineral of the vermiculite group, which sometimes becomes an important constituent of the rock, which also contains bright green crystals of a ferruginous enstatite (bronzite), and sometimes a horn-blendic mineral closely resembling smaragdite. A pale buff bronzite occurs in larger fragments than the green form of the mineral; and in the rock of Du Toit's pan an altered diallage is present. Opaline silica, in the form of hyalite or of hornstone, is disseminated through the greater part of the rock-masses, and they are everywhere penetrated by calcite. The analyses of the component minerals (given in detail in the paper) show that this once igneous rock is a bronzite rock converted into a hydrated magnesium silicate, having the chemical characters of a hydrated bronzite, except where the remains of crystals have resisted metamorphism. Except in the absence of olivine and the small amount of augitic mineral, it might be compared with the well-known Lherzolite rock. The diamonds are said to occur most plentifully, or almost exclusively, in the neighbourhood of dykes of diorite which intersect the hydrated rock, or occur between it and the horizontal strata through which the igneous rocks have been projected. The authors compare the characters of the diamonds found in different positions, and come to the conclusion that their source is not very remote from that in which they are now found. The mineral above-mentioned as resembling vermiculite is described by the authors as a new species under the name of Vaalite.—Note on a modified form of Dinosaurian ilium, hitherto reputed scapula, indicative of a new genus, or possibly of a new order of reptiles, by J. W. Hulke, F.R.S. The author re-examines Mantel's "Scapula of an unknown reptile" = Owen's "Scapula of Megalosaurus?" and adduces reasons for considering it to be a modified Dinosaurian ilium. He describes two new examples of the bone in Dr. Wilkins's collection, contrasts them with undoubted scapulæ of sundry Dinosaurs and existing reptiles, and proves their essential correspondence with the ilia of known Dinosaurs.—Note on a reptilian tibia and humerus (probably of *Hylæosaurus*) from the Wealden formation in the Isle of Wight, by J. W. Hulke, F.R.S. In this communication the author describes two saurian limb-bones, remarkable for the great expansion of their articular ends, and the shortness and smallness of their shaft. The features of the tibia are more like those of the tibia of *Hylæosaurus* than of any other Dinosaur. This resemblance, and the suitability of the humerus to the very massive articular end of the Hylæosaurian scapula, dispose the author to refer the bones to this saurian.

Royal Horticultural Society, June 17.—Scientific Committee.—Dr. J. D. Hooker, C.B., P.R.S., in the chair.—Specimens of *Puccinia malvacearum* (the hollyhock disease) were exhibited from Mr. Fish.—Dr. Masters showed a large slab of the wood of the Encine (*Quercus humilis*).—Mr. Worthington Smith exhibited a woodcut block of ebony which he pronounced nearly as good as box, but objectionable on account of its dark colour.—Dr. Denny showed flowers of a scarlet Pelargonium raised by him, in which the petals were remarkably persistent. He had obtained this horticulturally desirable quality by continuous breeding and selection from a variety originally manifesting it in a smaller degree.

General Meeting.—W. A. Lindsay, secretary, in the chair.—Prof. Thiselton Dyer commented on the interesting series of lilies exhibited by Mr. Barr, which illustrated four distinct geographical races all belonging in a wide sense to the same species. *Lilium bulbiferum*. *L. bulbiferum* proper was wild in Austria and Sweden; *L. croceum* in France, Switzerland, and North Italy; *L. davuricum* in Siberia, *L. thunbergianum* in Japan. It could not be doubted that these were all derived from a common parentage, and had been gradually differentiated as they migrated in different directions and became isolated.—He also described the coffee blight of Ceylon and South India (*Hemileia vastatrix*). A dried bush exhibiting the effects of the disease was shown on the table.—Dr. Hooker illustrated in some detail the light which the theory of a common parentage threw on the geographical distribution of closely allied species, varieties, or forms. He pointed out as particularly striking cases the cedars and the 5-leaved pines. As to the *Hemileia* it could not be doubted that it was a most serious enemy for the planters to contend with. He thought, however, that there was some hope that particular kinds of coffee might be found to be less liable to its attacks than others, and at Kew he had been making great efforts to procure and raise from seed the remarkably large-seeded West African kind with a view to its transmission to Ceylon.

Anthropological Institute, June 23.—Prof. Busk, F.R.S., president, in the chair.—Mr. Robert Dunn read a paper On ethnic psychology. The author dwelt on the importance of carefully studying the cerebral organisation of the typical races as the only way of elucidating the psychological differences which exist among them. Notwithstanding the labours of Gratiolet in that field of inquiry, a vast deal remained to be done. The author's convictions rested on the postulate that the brain is the instrument of the mind, and the consequent corollary was that the distinguishing psychical differences existing between various peoples depend greatly, if not altogether, on the structural differences of their brains.—A paper, by Mr. Rooke Pennington, was read, On the relative ages of cremation and contracted burial in Derbyshire in the Neolithic and Bronze ages. The object of the paper was to show that the impression that stone implements and contracted burial, bronze implements and cremation, are usually associated is quite erroneous as tested by the results of barrow-opening in the Peak of Derbyshire. The researches of Messrs. Bateman and Carrington on being tabulated proved that. Of "finds" containing stone implements, 65 per cent. were cases of contracted burial, 34 per cent. were burnt. In the Bronze, 58 per cent. were contracted; 38 per cent. were burnt. It was clear that those who deposited stone implements in the graves of the dead, and those who placed there articles of bronze, shared pretty equally the differences of custom in the interment of the body: so that out of 150 contracted entombments, 50 per cent. were accompanied by stone only, 12 per cent. by bronze; and out of 86 burnt cases, 46 per cent. afforded stone only, 14 per cent. bronze. The conclusion was fully borne out by examination of the contents of each tumulus. Several instances were given as showing that the Neolithic and Bronze peoples alike used both modes of burial.—A paper, by Miss A. W. Buckland, was read, On mythological birds ethnologically considered. The chief object of the author was to prove that in tracing the bird-legends to their sources, valuable ethnological results might be obtained, and a clue afforded to the migrations of man in Prehistoric times.—The president took the opportunity on this, the last ordinary meeting of the session, of announcing that the appeal of Council to the body of members at the anniversary had been so successful that the Institute was now out of debt.

Geologists' Association, June 5.—Henry Woodward, F.R.S., president, in the chair.—On the lower cretaceous beds of Folkestone, by F. G. H. Price, F.G.S. The town of Folkestone is situated upon the Folkestone Beds of the Upper Neocomian. These the author divides into four lithological groups, commencing with a sandy bed, which contains many phosphatic nodules, and which he considers to form the true division between the Folkestone and underlying Sandgate beds. The *Rhynchonella sulcata* bed, an important fossiliferous zone, lies at the base of the latter. The general character of these Folkestone beds is that of a loose yellowish sand parted by seams of coarse calcareous sandstone. Masses of branching sponge are especially plentiful in these rocks. The last bed of the Folkestone series is a very remarkable one, consisting of an irregular seam of large nodular masses, composed of coarse grains of quartz, glauconite, jasper, lydian-stone, and phosphatic nodules. Four feet of loose sand succeeds, capped by a band of pyritous nodules; and then occurs a seam of dark greensand (containing two lines of phosphatic nodules), largely charged with *Am. interruptus*, and other fossils in the form of rolled casts. The argillaceous beds of the lower gault, which follow, are frequently very dark in colour, and more or less parted off by lines of nodules, marking certain zones of life. The thickness of this sub-formation is about 28 ft. From the grey marl or upper gault it is separated by a nodule or passage bed of much importance; as this nodule bed marks the extinction of lower-gault forms and the introduction of others. The base of the upper gault may be known by the large quantities of *Inoceramus sulcatus*. The upper fifty feet consists of a pale grey marl, of which the portion subjected to analysis yielded 26 per cent. of lime carbonate.—On a collection of fossils from the U.G.S. of Morden, Camb., by H. George Fordham, F.G.S.

Entomological Society, June 1.—Sir Sidney S. Saunders, president, in the chair.—Mr. McLachlan exhibited specimens of the White Ant (*Calotermes* sp.), recently bred at Kew from a sample of the wood of the tree (*Trachylobium hornmannianum*) that produces the gum-copal of Zanzibar.—Mr. Stainton read a letter he had received from the Rev. P. H. Newnham, of Stonehouse, Devon, stating that he had taken two living specimens of *Deiopeia pulchella* on the Cornish side of the River Tamar. Mr. Stainton remarked on the early period of the year when the insects were captured as very unusual.—Mr. C. O. Waterhouse sent for exhibition a living specimen of a Mantid (*Empusa pauperata*) in the larva or pupa state, brought from Hyères by the Rev. Mr. Sandes of Wandsworth.—Mr. W. D. Gooch communicated a detailed account of his experiences with regard to the Longicorn Coffee-borers of Natal. Dr. Horn, of Philadelphia, stated that European Conifers, Limes, &c., planted in a public park at Philadelphia, were all killed by the larvæ of native species, such as *Callidium antennatum* and *Monohammus dentator*, though apparently in a healthy condition, whilst the native trees were not perceptibly affected. He was inclined to believe that the insects attacked healthy trees, but Mr. McLachlan stated that, according to the observations of most European entomologists, the European species of Longicorns did not attack living wood in a perfectly healthy state.—Mr. Butler communicated a paper On new species and a new genus of diurnal Lepidoptera in the collection of Mr. Druce.—Mr. Smith read a revision of the Hymenopterous genera *Cleptes*, *Parnopes*, *Anthracias*, *Pyria*, and *Stilbum*, with descriptions of new species of the genus *Chrysis*, from North China and Australia.

PARIS

Academy of Sciences, June 22.—M. Bertrand in the chair.—M. Dumas stated, in the name of the *Phylloxera* Commission, that after the theoretical researches of the Commission this body had commenced a practical study of the subject in the field. Agricultural police had been appointed for the preservation of those parts of France not yet invaded by the scourge.—The following papers were read:—Researches on solution, by M. Berthelot; a continuation of thermo-chemical investigations.—Presentation of some specimens of photography obtained with an apparatus constructed for the Japanese expedition, by M. J. Janssen. The photographs presented were of the sun taken with an objective (of 5 in. aperture and 2 metres focus), constructed of flint and crown glass in achromatic combination.—A mechanical note was presented by M. R. Clausius, entitled "On a special case of the Viriel."—Theory of the collision of bodies, with consideration of the atomic vibrations, by M. A. Ledieu.—Communication on the bitter lakes of the Isthmus of Suez, by M. Ferdinand de Lesseps. The author exhibited a block of salt cut out from the salt bank still existing in the centre of the great basin. This bank is calculated to have contained 970,000,000,000 kilogrms. of salt, and has now dissolved away to the extent of $\frac{1}{10}$ since the admission of the water of the canal. The superficial area of the salt bank is about 66,000,000 square metres, and it is composed of horizontal layers varying in thickness from 5 to 25 centims. The bank is believed to have been formed by the evaporation of Red Sea water poured into the lake basin during successive inundations; the amount of Red Sea water evaporated is about 21,000,000,000 cubic metres. The lake basin contains 2,000,000,000 cubic metres of water, giving an annual evaporation of 200,000,000 cubic metres. Twenty years ago rain hardly ever fell in the isthmus, but now tiles are obliged to be sent from France to roof the houses there. The author holds out great hopes of the practicability of filling a great basin in the interior of Algeria. A valuable table of numerical results accompanied the communication.—Geological topography of the environs of Aigues-mortes, a letter from M. Ch. Martins to M. Elie de Beaumont.—Observations on the subject of the reply of M. Faye to the criticism concerning his addition to Pouillet's memoir on solar radiation, by M. A. Ledieu. The author insisted that there was still a difference in the *principles* of thermodynamics between him and M. Faye.—Analysis of twenty-one samples of salt water from the maritime canal of Suez, sent by M. F. de Lesseps, by M. Durand-Claye. While Mediterranean water contains a solid residue of about 40 kilogrms. per cubic metre, the canal water contains, in some parts, 75 kilogrms., and never falls below 65 kilogrms. This fact is explained by the solution of the great salt bank before referred to. At Port Said the water is less salt than in the Mediterranean (24 to 26 kilogrms.) owing to admixture with Nile water.—On the employment of phenic acid for the preparation of wood, by M. M. Boucherie.—On the Cycadaceæ of the Paris basin, a note by M. Robert. Among a number of rolled flints from the confluence of the Nesle and Aisne between Ciry-Sermoise and Chassemy, the author found a number of stems which he considers to belong to the order named.—On the systems of quadratic forms, by M. C. Jordan.—M. G. Darboux made an addition to his note read on June 8, On friction in the collision of bodies.—Hydrographic map of Algeria, a note by M. E. Mouchez.—Phenomenon of mirage observed in Yffiniac Creek (North coast), by M. J. Girard.—Action of heat on the isomeric carbides of anthracene and their hydrides, by M. P. Barbier.—Chlorobromides of propylene: normal propyl-glycol, by M. E. Reboul. Only one chlorobromide of propylene has been known up to the present time, viz. $CH_2Br-CHCl-CH_3$ (Friedel and Silva). The author now makes known the four others, $CH_2Br-CH_2-CH_2Cl$ (normal), $CH_3-CClBr-CH_3$, $CH_3-CH_2-CHClBr$, and $CH_3-CHBr-CH_2Cl$.

BOOKS RECEIVED

Colonial.—Report of Progress of Geological Survey of Victoria, &c.: R. Brough Smyth (Melbourne).—Report upon the Rainfall of Barbados, and its Influence upon the Sugar Crops: Governor Rawson (Barbados).

Foreign.—L'Astronomie Pratique et les Observations en Europe et en Amérique: C. André et G. Rayet (Gauthier Villars, Paris).—Die neue Sternwarte der Wiener Universitat: Carl von Littrow.—Jahresbericht des Physikalischen Central Observatoriums for 1871-72: H. Wild (St. Petersburg).—Annalen des Physikalischen Central Observatoriums. H. Wild, 1872 (St. Petersburg).—Spectres Lumineux: M. Lecoq de Boisbaudran. 2 vols. 8vo. (Gauthier Villars).—Repertorium fur Meteorologie Kaiserlichen Academie, Redigirt: Dr. Heinrich Wild. Band iii.—Bulletin de l'Academie Imperiale des Sciences de St. Petersbourg, t. xviii., Parts iii. iv. v.—Bulletin de l'Academie Imperiales des Sciences de St. Petersbourg, t. xix., Parts i. ii. iii.

CONTENTS

PAGE
On Osteological Monograph-Writing 159
Pickering's "Physical Manipulation" 160
Our Book Shelf 161
Letters to the Editor:—
    Robert Brown and Sprengel.—Prof. Asa Gray 161
    On the Physical Action taking place at the Mouth of Organ-pipes.—Hermann Smith 161
    The Degeneracy of Man.—Hyde Clarke; Joseph Edkins . . 163
    Disuse as a Reducing Cause in Species.—G. J. Romanes . . . 164
    Longevity of the Carp 165
The *Challenger* Expedition, V. 165
The Figure of the Earth in relation to Geological Inquiry. By Prof. Henry Y. Hind. 165
Report of Prof. Parker's Hunterian Lectures "On the Structure and Development of the Vertebrate Skull," V (*With Illustrations*) 167
Fertilisation of Papilionaceous Flowers—Coronilla. By T. H. Farrer (*With Illustrations*) 169
Lenz's Doctrine of Ocean Circulation. By Dr. W. B. Carpenter, F.R.S. 170
Notes 171
Scientific Serials 174
Societies and Academies 174
Books Received 178

THURSDAY, JULY 9, 1874

THE COMET

TO those who are familiar with the triumphs which that most wonderful of modern instruments of research—the spectroscope—has achieved, the short time during which it has been at work will be most forcibly recalled by a reference to the circumstance that the comet which is now, astronomically speaking, a magnificent object in the northern sky, is the first one of any considerable brilliancy which has shown itself since the spectroscope has been adapted to the telescope.

The truly splendid comets which delighted us during the autumn of 1858, and for a brief space in the summer of 1861, made their appearance, in fact, during what we may term the pre-spectroscopic age; for, however little to the credit of modern science it might have been that the spectroscope was no employed in their investigation, the fact remains that they were allowed to pass away mere telescopic objects, and that two opportunities were thus lost such as, perhaps, may not offer themselves again to the present generation of men.

I propose, in the present paper, to state some points of inquiry regarding comets in which the spectroscope may help us, with a view of showing how much closer is our grip of celestial phenomena when physical astronomy, in its widest sense, is superadded to the older astronomy, and to indicate the numerous gains to knowledge which may be hoped for if adequate telescopes, properly armed with spectroscopes, are employed both here and in the southern hemisphere upon the present visitor.

Omitting all reference to the paths of comets round the sun, with which mechanical astronomy has to do, there are perhaps but few points in which the spectroscope cannot help us; somewhat unfortunately, however, there is one in which it appears powerless, and that precisely one of the greatest difficulty in cometary theory. I allude to the apparent sweep of the tail round the sun when the comet is at its perihelion point, which has suggested to Faye a theory of a repulsive force due to solar heat, and which perhaps is one of the most mysterious phenomena which we witness in the skies. Leaving this aside, however, there are many questions relating to what Sir John Herschel terms their "interior economy," in which, undoubtedly, the guesses of telescopic observers may be turned into hard, detailed fact.

Let us briefly refer to some of these points.

Generally speaking, as a comet approaches the sun it gets brighter and its tail lengthens, whether the nucleus is intensely stellar, as in the present case, or not; in some cases a violent action may be observed; *aigrettes*, or jets, make their appearance; and the nucleus, or head, is surrounded, or partly surrounded, by envelopes or shells, very obvious and with marked boundaries, and these are visible in some cases at the commencement of the tail.

Now, of course, if any or all of these luminous phenomena were due to the reflection of sunlight by masses of whatever kind not luminous in themselves, then the spectrum would be the same from all, differing only in intensity, and the spectrum would be the true solar spectrum if there were light enough, and a dim continuous spectrum if the part of the comet under examination were dim.

If, on the other hand, the masses were self-luminous and consisted of vapours not too dense, then we should get a characteristic spectrum proving first the existence of vapours driven into incandescence; and secondly, if the observations went far enough, the precise quality or nature of the vapour would be determined for us by the spectroscope. Thanks to the labours of Donati, Huggins, Secchi, Wolf, Rayet, Vogel, and others, the brightest portions of the comets which have appeared since 1864 have been examined with the undoubted result that they consist, in part at least, of not very dense incandescent vapour. I say in part, because in some cases the continuous spectrum, which may denote dense vapours, or perhaps vapours of relatively greater molecular complication, or again even glowing solid substances, has been so strong as almost entirely to mask the bright lines or bands by means of which the presence of the rarer or simpler vapours is determined.

Nor is this all. Not only have lines been seen, but their positions have been determined with some degree of accuracy, although it must be pointed out that the opinions of authorities do not coincide as to the actual materials indicated or as to the interpretation to be put upon the observations. This is not to be wondered at, considering the amazing delicacy of the research and the few opportunities there have yet been of making perfectly satisfactory determinations.

The most searching criticism of the results hitherto obtained appeared some little time ago in *Poggendorff's Annalen* from the pen of Dr. Vogel (NATURE, vol. ix. p. 193), and it will be well to briefly glance at some points which result from his inquiry. Donati, in the first observations of this nature made in 1864, determined the existence of three bright bands, but made no attempt to determine the substance from which the light proceeded. Huggins in 1866 made the first attempt in this direction, and came to the conclusion that, like the nebulæ, the comets might be composed of nitrogen, as in the spectrum of the comet visible in that year there was a single line which nearly, if not quite, coincided with one of the brightest lines of that element. In 1868, however, the idea of nitrogen comets was abolished, as the idea of nitrogen nebulæ has been since; and the three bands, which were again observed in the comets visible in that year, were found to coincide with those of olefiant gas. Hence it was suggested by Huggins that they consisted of carbon vapour. He writes:—"The great fixity of carbon seems indeed to raise some difficulty in the way of accepting the apparently obvious inference of these prismatic observations. Some comets have approached the sun sufficiently near to acquire a temperature high enough to convert carbon into vapour. Indeed, for these comets a body of great fixity seems to be necessary. . . If the substance of the comet be taken to be pure carbon, it would appear that the nucleus had been condensed from the gaseous state in which it existed at some former period. . . . If we were to conceive the comet to consist of a compound of carbon and hydrogen . . . other difficulties would arise in connection with the decomposition we must then suppose to take place . . ."

It is clear that Mr. Huggins' opinion is that a comet consists of carbon; that the vapour is carbon vapour driven into incandescence by a temperature high enough to volatilise carbon, and not the vapour of a volatile hydrocarbon.

Such is not M. Vogel's view, and I confess it is not mine. After giving details of the observations of the nine comets examined between 1864 and 1871, M. Vogel thus analyses them:—

> "Of these nine comets, there is only one (1870) for which we have no observations as to the position of the bright bands. Of the remaining eight, the spectra of five (1, 2, 4, 7, and 9) have shown *no* agreement with the hydrocarbon spectrum. As regards the Comet II. 1867 the supposition is offered that its spectrum was similar to the spectrum named; as to Encke's Comet III. 1871, it remains uncertain in which class it is to be reckoned (Huggins' observations being at variance with those of Young and myself). There remains only the Comet II. 1868, for which Huggins' and Secchi's observations assert a probability of coincidence of the lines in its spectrum with those in the spectra of volatile hydrocarbons.
>
> "It thus appears a somewhat questionable view, that the comets consist of such matter; and we should, I think, content ourselves with the deduction that a portion of the light emitted by the comet is its own light, and very probably from glowing gas."

Hence, then, the whole question of the true material of which that part of the comet consists, the spectrum of which has been already observed, must be acknowledged as being still *sub judice:* and this is a matter of the first order of importance, on which the present comet may throw much light.

But one of the most hopeful points is this: the comets up to the present time have been either so small or so distant that the record of aigrettes or envelopes on the spectrum has not been determined; nay, the comets might have been deprived of those appendages, hence the statement concerning the spectrum is a very general one; there has been no sufficient opportunity of localising the spectrum-giving region or regions.

What a glorious harvest will be reaped should the jets appear as decided as in the comet of 1861, or in Halley's comet at its return in 1835; "jets, as it were, of flame, or rather of luminous smoke, like a gas fan-light," which, as described by Sir John Herschel, "varied from day to day as if waving backwards and forwards, as if they were thrown out of particular parts of the internal nucleus or kernel, which shifted round, or to and fro, by their recoil, like a squib not held fast."

Or again, suppose the system of concentric envelopes is developed to the same extent as in Donati's comet, in which the action at all points of the nucleus, to follow Sir John Herschel's reasoning, was probably more general, a result due to a more uniform chemical constitution.

Hence the comet may leave us a rich inheritance in the shape of "spectrum of jets," or "spectrum of envelopes;" and from what I have already seen dimly (for such observations are beyond my instrumental power), the former is the more probable, and in the nucleus we may have the equivalent of the sun, or the carbon pole of an electric lamp, with a continuous spectrum, and in the jets phenomena identical with those presented by solar storms, or the electric arc, that is, lines of various lengths indicating various vapours, shooting out or extending to various distances according to their volatilities, or vapour densities.

We seem, indeed, to have got a true physical approximation to this state of things in the comet of 1868, for Mr. Huggins observed that while some of the lines thinned out as one sees them do in the ordinary spark by using a lens, quite independently of the general visibility of the vapour, others did not so thin out, but retained their breadth till they disappeared altogether.

The extent to which this action will go on will obviously depend upon two things, first the temperature and secondly the materials of the comet; and this raises an important question, which perhaps is easier of solution than the determination of the materials ejected, should that phenomenon be spectroscopically recognisable.

I have already communicated to NATURE the fact that to me the continuous spectrum of the nucleus appears deficient in blue rays. The effect of this upon the colour of the nucleus would be to give it a yellowish tinge like that of a candle flame, and for the same reason.

Dr. Vogel, in the paper to which I have already referred, deals with this question of colour, stating that:—

> "Dr. Zenker arrives at the conclusion that there must be water-vapour in the comets; since they have, according to Schmidt, a yellowish-red colour, and the sun's rays, when they pass through a considerable thickness of aqueous vapour, are coloured thus. But apart from the consideration that sunlight has a yellowish-red colour on passing through other vapours as well as aqueous, I would remark that we must take the proper light of the comet, which appears from spectral analytic observations to be generally more intense than the reflected light, as determining its colour. According to the observations made, we should expect that the comet is, on the whole, of greenish or greenish-blue colour, since all the spectra consist, as we have seen, of two or three bands of light, of which one is in the yellow, the second and brightest in the green, and the weakest in the beginning of the blue. Of the (generally very faint) continuous spectrum, only the brightest part—yellow, green, and commencement of blue—is visible. The entire image, therefore, even where the weak continuous spectrum appears, will seem of greenish colour. Colour-data have been furnished by other observers besides Schmidt; and the head of the Comet 1811, *e.g.* had, according to Herschel, a greenish or bluish colour; the nucleus was slightly red. The colour of Halley's comet, at its return in 1825, was a bluish-green (Struve). Winnecke says of the comet of 1862, 'The colour of the neck appears to me yellowish; the coma has bluish light.'"

It will be seen that these remarks are quite in accordance with the suggestion. Dr. Zenker attributes to absorption the effect which I ascribe to defective radiation, and if it should be determined that the spectrum of the nucleus is truly deficient in blue rays, then a great point will be gained, *for its temperature must be low.*

Angström, whose death the world of science is now deploring, lived to say that he conceded that different molecular arrangements of the same element might give us different spectra; and Roscoe and Schuster have recently placed beyond all doubt that, besides the well-known high temperature spectra of sodium and potassium, there are other spectra appertaining to the vapour of these elements at a lower temperature.

Now these spectra are *channelled-space spectra*, that is similar in character to the spectrum which has already been observed in the case of comets; and if such spectra be obtained for all elements (and I have already added to the list), if a comet be a body at a low temperature, it is such spectra as these that we shall see, and not line spectra. Further, in the case of compounds in which the molecules which give us these new spectra enter into combination, we may possibly dissociate them and observe their spectra at a much lower temperature than we can drive the higher molecular arrangement of the solid into vapour,

Such considerations as these derive additional interest and importance from the beautiful researches of Schiaparelli, which connect comets with meteorites.

Modern science acknowledges that comets are individual members of meteor swarms—not that meteors are comets' tails, as some think; this idea is, one may say, impossible to reconcile with facts—that one difference at any rate between a comet and a meteor is that one is self-luminous, the other is not till it arrives with in the limits of our atmosphere. If this be acknowledged, then to what is this difference to be ascribed? A possible cause is certainly a difference of chemical constitution—a difference between materials incandescent at a high temperature and materials incandescent at a low one. It is not necessary to stop to inquire how this temperature has been arrived at, but it is important to show that the question of temperature is one of the very first points to be attended to by those who can bring sufficiently powerful instruments to bear upon the present comet, and that the question of its actual chemical constitution is bound up with it.

But whatever be the temperature of the head there is another point which must not be lost sight of Sir John Herschel writes concerning Halley's comet: "The bright smoke of the jets, however, never seem to be able to get far out towards the sun, but always to be driven back and forced into the tail, as if by the action of a violent wind rolling against them—always from the sun—so as to make it clear that this tail is neither more nor less than the accumulation of this sort of luminous vapour, darted off in the first instance towards the sun, as if it were something raised up, and as it were exploded by the sun's heat, out of the kernel, and then immediately and forcibly turned back and repelled from the sun." Here we have the question raised not only whether the envelopes consist of different materials, but whether the tail is not entirely or in part self-luminous: the present comet may show that this point is not so satisfactorily settled as it is supposed to be in favour of reflected light.

Such then are briefly some of the questions at issue. It is to be hoped that our beautiful visitor will answer some of them for us, and that when it leaves our northern skies the work may be carried on in the southern hemisphere.

J. NORMAN LOCKYER

THE CHANNEL TUNNEL

WE fear there are still many who fail to see that any good can come of scientific research unless it has some well-defined "utilitarian" object in view. Even in this and in other countries that are in the van of civilisation and in which education is comparatively wide-spread, the majority of mankind can appreciate a benefit only when it takes a concrete and tangible form. That love of knowledge for its own sake, that noble inquisitiveness which has been so fruitful in results during the last two hundred years, even yet belongs to comparatively few, who are still regarded by the many with a kind of impatient pity as mere unpractical hobby-riders. Still the people who talk in this way are proud enough of the glory which their great men have shed upon their country, and would not willingly, we believe, part with it for money were this possible; and indeed how would this country appear among the nations were she deprived of the inestimable inheritance which her great sons have bequeathed to her in every department of intellectual activity? Happily, however, the race of those who decry single-eyed scientific research is getting sensibly smaller; and we firmly believe that as education improves and as higher education spreads, carrying with it the results of this same scientific research, it will disappear.

Still, a little consideration might show those who are ever ready to cry "what's the good?" that since all so-called "practical" schemes are concerned either with man's own body or with the surrounding universe, an essential part of the basis of any scheme is a thorough knowledge of the material on which it is proposed to work. Such a knowledge it has over and over again been shown is only to be attained by abstract scientific research, by investigation conducted as if the only end in view were a thorough knowledge of the subject in hand in all its scientific aspects and relations. Many instances could be given, and indeed are every day occurring, of the highest practical results unwittingly following from such investigations; and to the sceptic we could not recommend a better example of how indispensable is thorough scientific research as a basis for the useful arts than the results of the investigation into the geology of the Channel which Mr. Prestwich (the newly elected Oxford Professor of Geology) presented to the Institution of Civil Engineers last December, and which, with the subsequent discussion and maps, has just been published in a separate form. This study of the strata which underlie the Channel, and which seems to us an almost perfect example of close and careful reasoning on physical facts, is now brought forward to enlighten the projectors of a tunnel between England and France as to the nature of the material with which they will have to work; but Mr. Prestwich distinctly states that the various formations are considered "irrespective of their relative merits in any other than a geological point of view."

Mr. Prestwich's plan is to discuss carefully all the strata which underlie the Channel, from the London clay down to the Palæozoic series, exhibiting distinctly their lithological characters, dimensions, range, and probable depth, and from these data deducing his conclusions as to the suitability of each formation for being pierced by a tunnel. The investigations of himself and others on which Mr. Prestwich's paper is founded were mostly undertaken from no practical point of view, and before a Channel tunnel was thought of. Mr. Prestwich, many will be glad to think—grateful, we hope, at the same time for this very practical result of pure scientific research—concludes that from a geological point of view it is quite practicable to construct a tunnel underneath the Channel, although to do so with safety it will be necessary to go very deep down. But an excellent idea of the results of the investigation will be obtained from the following clear summary with which Mr. Prestwich's paper concludes:—

"In the London clay there exists a perfectly impermeable bed of sufficient thickness, but nowhere between the two countries, except probably at points where the distance presents apparently insuperable difficulties. The lower chalk or chalk marl affords a comparatively impermeable deposit, also of sufficient dimensions: but from its having a calcareous base, and from the possibility of fissures, with the absence of a protecting overlie, it has great uncertainty. In the gault there is another impermeable stratum, but of dimensions too small. The lower greensand contains no beds sufficiently continuous and impermeable. The Weald clay ranges about half-way across the channel; and if a belt of it should possibly pass round at the north end of the Varne and range to Wissant, it might prove to be worth further inquiries. In the Kimmeridge clay there is again a deposit of sufficient dimensions, but with a subordinate band which may be sufficiently permeable to present difficulties, whilst, though it comes to the surface on the French coast, its depth on the English coast must be very considerable. There is, however, just a chance that the Kimmeridge clay may in mid-channel be overlapped unconformably, and at a slight angle, by the Weald clay, and in that case they might for all purposes be considered as continuous strata. The Oxford clay presents similar difficulties, in addition to its greater depth and inaccessibility. In the secondary strata the irregular lie of the strata, and the presence of faults, are contingencies important to be considered.

"On the other hand, the great mass of the Palæozoic rocks so protected by impermeable overlying strata, is of such great dimensions, and so compact, and holds its range so independently of the more irregular range of the secondary strata, that it offers the conditions most favourable for the secure construction of a submarine tunnel; and that such strata can be worked in safety and for considerable distances under great bodies of water, has been proved at Whitehaven and Mons. But, on the other hand, the depths of these old rocks below the surface is very great, and they are much more dense and harder than the overlying formations.

"There is another important problem in connection with the Palæozoic rocks which such an undertaking might help to solve. The great question of the range of the coal measures under the south of England has lately come prominently into notice; and it was, in fact, in inquiries connected with that question that the foregoing considerations presented themselves to the author. The rich coal basin of Mons and the north of France has been traced to within thirty miles of Calais, where it thins out; but, like the coal basins of Liege, Aix, and Westphalia, which form separate sections of the same great trough, to the eastward, so there is reason to suppose that other sections of the trough set in on the westward, forming other coal basins, which possibly range to the west of England (Somersetshire), passing under the north-eastern part of Kent and the Thames. Any such work, therefore, as a submarine tunnel in these Palæozoic rocks could not fail to throw much light on the subject; while, in case it were to hit upon the line of strike of the coal measures, and could be carried on along that line, the work might prove otherwise remunerative, and tend to solve the great problem which interests so largely both geologists and the general public.

"Such, briefly, are the conditions which bear on the construction of a submarine tunnel between France and England. The author is satisfied that, considered on geological grounds alone, it is in one case perfectly practicable, and in one or two others it is possibly so; but there are other considerations besides those of a geological nature, and whether or not they admit of so favourable a solution is questionable. In any case the author would suggest that, the one favourable solution admitted, it may be desirable, in a question involving so many and such great interests, not to accept an adverse verdict without giving all those other considerations the attention and deliberation which the importance of the subject deserves.

"Under any circumstances, the difficulties are formidable. Whether or not they are insuperable are questions which may safely be left to Civil Engineers. The many and great obstacles overcome by engineering science in late years lead the author to expect that, should the occasion arise, and the attempt be considered worth the cost, the ability to carry it out would not be wanting. Various preliminary trials are, however, indispensable, in order to clear up some of the geological questions before a balance of the comparative advantages presented by the different formations could be satisfactorily settled, and before the grounds for action could be accepted."

From this it will be seen that the possibility of a Channel Tunnel remains now only with the engineers to decide. Geology has told them all the natural conditions under which they will have to work, so far as these can be known without actually tunnelling; and since so cautious a reasoner as Mr. Prestwich thinks it possible to carry out the scheme from a geological point of view, we should think that if it could be proved that the undertaking would pay, our engineers would be eager to show that the resources of their art are quite equal to its successful accomplishment.

OWENS COLLEGE "ESSAYS AND ADDRESSES"

Essays and Addresses. By Professors and Lecturers of the Owens College, Manchester. (London: Macmillan and Co., 1874.)

THIS book is due to the natural desire of the teaching staff of the Owens College to have some memorial of an event of the first importance in their own history, and to give expression to the hopes that animate the institution. The Owens College was founded by a single legacy a quarter of a century ago—for the creation of a college in which Lancashire lads might study at home the "branches of learning commonly taught in the English Universities." It first became known in connection with its first Principal, Scott, a writer who has left nothing which explains the high rank he held among his contemporaries and especially the influence he unquestionably exercised over every young man with whom he was brought into contact. Under him, however, the College did not flourish—the number of the day students sank at one time as low as 25—and it was only after the appointment of the present Principal, Dr. Greenwood, that it began to take root in Manchester. It has now about 350 day students—not including the medical students, who have been added only this session—and nearly 800 evening students. Curiously enough, what happened in Glasgow to the disappointment of many of the well-wishers of the University, happened also in Manchester. When the new buildings, with all their increased convenience for study, were opened, it seemed natural to anticipate a great increase of students. Nothing of the kind took place. Students seem to come and go to college because they want to be taught, not because they are to have beautiful buildings to be taught in. The effect will certainly be considerable, alike on teachers and on taught, of the more commodious buildings recently erected in Glasgow and in Manchester, and it will be felt more and more as time goes on. The fact that it is not felt at first shows, however, that the wants that are satisfied by university teaching lie so deep down that an external event like the inauguration of new buildings scarcely influences them.

The success which the Owens College has thus attained in a quarter of a century is due to much hard work—to careful and deliberate adaptation not merely to the wants of the time, but to the claims of real culture—and above all of course to the fact, which that success proves, that in Lancashire, or that portion of it of which Manchester is the capital, there is a real demand that the higher education may be brought home even to the doors. This book serves as a record of much of the work done—and an expression of the ideas of the teachers whose spirit has made and still makes the Owens College. No one who glances at the titles of the fourteen essays and addresses of which it consists can fail to be struck with the variety of the teaching. It accomplishes the task laid upon it by its founder, by teaching nearly everything commonly taught in the English Universities. We find two Professors of Classics, one of Oriental Languages and one of Modern Languages, two of Natural Philosophy, a Professor of Natural History, and a teacher of Geology, a Professor of Chemistry, a Professor of Engineering, a Professor of Jurisprudence and Law, a Professor of Physiology, and two gentlemen who seem to be three or four Professors rolled into one, the accomplished incumbents of the chairs of "English and History," and of "Logic, and Mental and Moral Philosophy, and Political Economy." Besides these, there are at least half a dozen more, the Professors of Mathematics, the Professors of three or four Medical subjects, the additional lecturers on Law, on Organic Chemistry, and so on, who put in no appearance in the volume. The College is in fact equipped with a staff of teachers which bears favourable comparison with that which is usually found in older Universities. The Medical department has been added only this session ; the Law and Jurisprudence department has recently made a considerable step in advance. Except that several of its members are evidently overburdened with subjects too large for any single man, the staff of the College is reasonably complete, and most things can be learned in it which are taught elsewhere.

We turn with interest to the volume before us to discover, in the choice of their subjects and in the manner of treating them, the aims and tendencies of the professors and lecturers. What is most noticeable, and it cannot fail to strike even the casual reader, is the caution, the moderation, we had almost said the conservatism which is characteristic of most of them. People are still tempted to associate the name of Manchester with everything that is "advanced," and we look in such a book as this for a daring championship of educational and scientific novelties. From the first words of the President's opening address to the last words of the essay which closes it, the tone of responsible thoughtfulness, of the wish to be just and true more than to be vigorous or startling, is never to be mistaken. The Duke of Devonshire the President, and Dr. Greenwood the Principal, unite in urging that the older class studies—those connected with literature—should not be pushed aside and comparatively disregarded, and that the newer studies should be taken up in their full depth and breadth, not in a fragmentary or superficial manner or with any supposed reference to their immediate application. These cautions are supplemented, indeed, but they are not contradicted, by Prof. Roscoe and Balfour Stewart, who urge, the one that original research is a powerful means of education, and that original research should be organised, as it has already been to some extent, especially in his own department ; the other that we should set about great national studies, establishing a watch, for instance, on the sun, "a creator of disturbances on the greatest possible scale, who is ever ready to afford us information about himself at the smallest possible cost." Mr. Reynolds follows them with a demand for a national commission to experiment on heat engines, and the conditions under which they could be practically worked, economically, or efficiently, or both, to higher pressures than we now attempt to use, so as to get more work out of our coal and our machinery, and perhaps some day to enable a lightweight jockey to fly at the rate of 200 miles an hour. After these speculations and demands, which are certainly significant of the modern age, follows Prof. W. C. Williamson's cautious and copious discussion of the theories of natural selection and evolution, as tested by primeval vegetation. We call it a conservative paper because the conclusion of the writer is that among the innumerable facts known and co-ordinated about the primeval vegetation, there is little sign that the laws of natural selection and evolution have operated to a large extent in transforming the vegetable species of the pre-carboniferous strata to those with which we are now familiar. But Prof. Williamson is absolutely frank in his admission of the new laws, and singularly candid in accepting any explanations which they seem to offer. He admits "that by the help of natural selection man has brought into existence many new varieties of pre-existing plants and animals, most, if not all of which, were his protecting hand withdrawn, would soon revert to their primal forms. We have no evidence that unaided nature has produced a single new *type* during the Historic period. We can only conclude that the wonderful outburst of genetic activity which characterised the Tertiary age was due to some unknown factor, which then operated with an energy to which the earth was a stranger, both previously and subsequently." It is in a bolder spirit that Prof. Bryce speaks of the new Judicature Act, a measure which throws us back in principles and in practice many centuries, and which is, in his view, "a reform in English law greater in some points of view than we have had since English law itself began to exist." The note of conservative caution returns on our ears in the two last essays on the Relation of the Railways to the State, by Prof. Jevons, and on the Peace of Europe, by Prof. Ward. The conclusion of the former is emphatic, and altogether hostile to the movement party who advocate the State purchase of our railway system. There are few questions deserving to be more seriously studied by politicians or likely to need more serious study, for in the changes and chances which affect our governments, some new men may some day drift with us into schemes which would be in themselves imprudent, and which would be foolish except by way of preface to a more comprehensive measure. We could not take the railways over, Prof. Jevons thinks, for less than a thousand million sterling, which is about double their commercial value. The attempt might be all but ruinous to the nation, and the results would be altogether disappointing. But among the middle and upper classes, who own the railways, there is certain to be a considerable feeling in favour of a scheme which would be fruitful of so much pecuniary benefit to themselves, and it is well to have it discussed beforehand as thoroughly and as thoughtfully as it is discussed here. It is in useful conservatisms such as these that Universities often do their greatest services. They are mints at which the coinage that is passing current in the commoner exchanges of the world may be thoroughly tested. Prof. Jevons offers statesmen and politicians an admirable discussion, luminous with the most practical good sense. Like his colleagues, Prof. Ward is conservative in the sympathies of his essay. We have been engaged for many years in breaking down the venerable theory of the Balance of Power in Europe, and we have been attempting to build up in its stead a sort of Temple of Doctrinairism—sacred to a goddess of international arbitration, who is to be capable of the cure of all international ailments. Prof. Ward applies the touchstone of his comprehensive historical knowledge to both. He is utterly hostile to the doctrine of Spinoza that, as the natural state of man is a state of war, no nation is bound to observe a treaty longer than the interest or danger that caused it continues. But the old treaty basis of the peace of Europe having broken down, "the remedy for the danger accruing with new force to the peace of Europe is to be sought, not in an abandonment of the principle of joint action, but in an enlargement and elevation of it, and in the progress of that enlightenment which, instead of enfeebling, strengthens the common action of men and of states. For it is with nations as with individuals. The cultivated, and by culture enlightened, mind is and must be on the side of progress and peace against that of darkness and conflict. The obscure men, like the unformed nationalities, are at once materials and causes of that which disturbs, unsettles, and retards personal and national and international life. Where the education, and more especially the higher education, of a country is fostered, there lie the best promises of progress and of peace."

We do not attempt any detailed criticisms of the several essays. The subjects chosen by fourteen professors on which to address the world are likely to be reasonably well chosen, and the addresses delivered on them are pretty sure to reward the attention of the reader. They strike us as very well chosen; they sufficiently represent the real variety of teaching and of manner of teaching in the institution; they contain complete and occasionally brilliant discussions of subjects of very considerable general interest. They are the expressions of the inner spirit of a seat of learning in which science holds a higher place than she has usually done, but in which there is the most emphatic and continual protest against the degradation, or neglect either of literature or of science. They show a body of teachers full of modern life, and at the same time singularly moderate, truthful, and reverent. Several of the essays are historical studies, and in these cases the reputation of the writer is a sufficient guarantee of completeness. In their collected form the "Essays and Addresses" warrant high hopes of the future of the Owens College. In a sense—perhaps a somewhat too literal sense—it is what it was once called in a journalistic epigram, the University of the Busy. With its present staff it will certainly continue the tradition which connects the older Universities with the highest learning of the time.

W. J.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Sir John Herschel's Letters

IT is known to many through the numerous applications I have made, that a collection of the letters of Sir John Herschel is in progress. For the many and valuable contributions, as well as for the kind and sympathetic expressions which I have been favoured with, I cannot be too ready to express once more my sincere acknowledgment; and when I recall these to mind I hesitate to take any less private step to further the end in view, or, by venturing on a public appeal, to forego the advantage of more direct communication. Several considerations however—which not even your courtesy in allowing this letter to appear in the columns of NATURE would justify me in dwelling upon—forbid me to depend solely on the activity of a single importunate pen. The correspondence in question covers more than half a century. Many of the correspondents were of a former generation, and their present representatives are known to but few. I may instance the names of Davy, Young, Wollaston,—not to mention many continental savans—in illustration of this. Many others, less eminent, but not the less recipients of letters which the student of scientific history will prize as containing the germs of much of the force whose impetus we now feel, were hardly known by name beyond their own immediate circles. Many more, as I would fain believe, who either themselves corresponded with my father, or knew him in his letters to their relations, are even now in possession of such letters, and may not be unwilling to let them be seen. Lastly, I hear too much of autograph collectors not to feel a keen desire to make their instant acquaintance. Have they not devoted themselves to preserving individual letters, no matter how trifling, from the fate which has—alas too often—overtaken others, no matter how numerous, or how valuable!

In my applications hitherto I have been constrained to repress the expectation of immediate publication. I am not at liberty to depart from that now. But that the materials which I may now be permitted to store up *will* eventually help to form the foundation of such a monument as may be fitting—this requires no student of history to tell us. That it may be amply provided for now, before it is too late, is my chief anxiety. For my time is limited, and I have drawn too many blanks not to feel that every year increases their number, let who will take my place.

I apologise for so long a story, and will only add in the most general terms that I appeal to all who possess, or know of the existence of, autograph letters of Sir John Herschel—no matter how insignificant they may seem, for collation with others can alone supply a true test—but of course with due regard to personal consideration—to communicate with me at once. It is hardly necessary to say that all autograph letters will be returned, and that any restrictions will be attended to.

21, Sumner Place, Brompton, S.W. J. HERSCHEL

Coggia's Comet

YOUR readers may be interested to learn that the light of the comet is by no means strongly polarised. On the 2nd and 4th instant I examined it with a double-image prism, but could not with certainty detect any difference between the brightness of the two images. I also examined it with a plate of right- and left-handed quartz in the principal focus of the 4-inch telescope and a Nicol's prism packed among the lenses of the eyepiece, but could not detect any traces of colour. With a Savant placed between the eyepiece and the eye no bands were detectable. But on the 6th, about midnight, when the comet was shining very brightly, I could perceive a difference in the brightness of the two images with the double-image prism, indicating polarisation *in* the plane passing through the sun's estimated place. But I was still unable to detect any traces of polarisation either with a Savant or Biquartz, or with a plate cut from a natural crystal of right- and left-handed quartz giving a band across the field in which the two crystals overlap; a form of polariscope which has been found on other occasions very delicate for faint lights.

If the tail of the comet consisted of a *fine* dust not in a state of incandescence reflecting or dispersing the sun's rays, we should expect its light to be completely polarised. We seem, therefore, driven to assume, either, 1, that the tail consists of fine incandescent particles; or, 2, of particles whose diameter is not small compared with the wave-length; or, 3, of incandescent gas; or, 4, possibly of all three of these states combined.

A. COWPER RANYARD

Photographic Irradiation

IN a letter to NATURE, vol. ix. p. 183, I gave a short description of some experiments on photographic irradiation. The conclusion to which these experiments pointed was that there is a kind of photographic irradiation, caused either by the bright light producing an intense state of chemical activity, which has the power of extending itself in every direction; or what seems more probable, the parts of the collodion on which the bright light is falling become luminous and reflect light to the surrounding parts of the sensitive film, and thus extend the chemical change on each side of the true optical boundary line. As the subject is at present under discussion, I send you the results of the following experiments, which seem to support the above conclusion. In a darkened room a vertical opening 18 in. by 5 in. was made in the shutter; over the opening was fixed a piece of paper thick enough to stop most of the light, and only allow as much to pass as would give a decided but not deep photographic impression. Three long, narrow, parallel openings were cut in the paper, one opening was left clear to the sky, the next was covered with one thickness of tissue paper, and the third with two thicknesses of tissue paper. There was thus produced three parallel bars of different brightness on a uniform and darker ground. Sensitive wet plates were prepared in the usual way on glass and opaque black plates; across the front of the plates, and almost in contact with the collodion, was fixed a horizontal bar of thin blackened metal in such a position that it would cross the image of the luminous bars in the camera. The photographs, after exposure, were developed in the usual way, and it was found that the shadow cast by the horizontal opaque bar was not bounded by straight lines, but the ends of all the bright bars projected into the shadow, and the brighter the bar the farther it projected. I had no means of measuring accurately the bar and its shadow, but there seems but little doubt that the bright bars extended underneath the opaque bar, whilst the edge of the darker ground at the side of the bright bars gave the correct line of the shadow. Now this extension of the bright bars could not have been caused by the reflection from the back of the plate, as this result was always got whether glass or opaque black plates were used. Nor could it have been caused by the oblique pencils referred to by Lord Lindsay and Mr. A. C. Ranyard, because, the opaque bar being close to the collodion, these pencils could not get underneath. The natural conclusion seems to be, that this extension of the bright bars must have been caused by some molecular reflection taking place in the collodion. This form of irradiation can easily be distinguished from the irradiation produced by reflection from the back of the plate, as the latter is simply a sort of haze surrounding the bright object, extending some distance from it, and gradually fading away, whilst the former extends a very short distance and has a well-marked outline, though not so sharp as those parts of the image where there is no irradiation. The irradiation produced by reflection from the back of the plate, and some forms of irradiation due to the imperfections of the lens, though fatal to artistic photography, yet do not interfere much with its scientific value, as they do not affect the accuracy of outline, though they do affect the clearness of the photograph. Molecular irradiation, on the other hand, whilst it scarcely affects artistic photography, is fatal to scientific accuracy. The manner of preventing this latter form of irradiation has been already pointed out, namely, by reducing the intensity of the light falling on the sensitive surface to only that necessary to produce a distinct impression. In artistic photography this is almost never possible on account of the different amount of light on the different parts of the subject, while for scientific purposes this may almost always be done. The imperfections of the image due to the lens seem to be as various as the forms of lenses; one lens used in the experiments gave a curious double hazy-image of the bright object. When the image is near the centre of the "field" the double image fits over the true image, producing an effect somewhat similar to, and was at first mistaken for the effect of reflection from the back of the plate. At first this double image was somewhat puzzling, as it always made its appearance even when opaque plates were used. The two images were, however, afterwards separated by bringing the true image near the outside of the "field," when the true image and its double were photographed alongside of each other.

The following simple experiment illustrates this molecular form of irradiation, and shows how much the definition of the image depends on the nature of the surface which receives it. Take a camera obscura and throw the image on some translucent substance such as opal glass; paint a small part of the glass with some opaque white substance; bring into the "field" some brilliantly illuminated subject, such as branches of trees against the sky; examine the image from the lens side of the glass, when it will be found that the image over the opal glass is hazy and indistinct, whilst the part of the image on the paint shines out brilliant and sharp.

JOHN AITKEN

Darroch, Falkirk, N.B. June 16

Lakes with two Outfalls—A Caution

LLYN CREIGENEN (the larger of the two lakes of that name), situated about five miles S.W. by W. of Dolgelly, has *apparently* two natural outlets—one at the east, the other at the west end of the lake; both streams ultimately fall into the estuary of the Mawddach. The two outlets are on nearly the same level, the one at the east end being perhaps a trifle higher than that at the west end. The whole of the waste water at present passes through the western outlet in consequence of an artificial dam of turf having been made across the eastern channel. There are no indications on the ground which would lead anyone to suspect that either of the outlets had been artificially formed; the general contour of the surrounding country would rather favour the contrary view.

I was, however, informed last week by a man who had lived eighteen years in the district *that he had been told* that originally the only outlet was that at the west end of the Llyn, and that the other outlet had been made many years ago for the purpose of getting a better supply of water to some mills which then existed, but which do not now exist, on the stream to the east of the lake. If this story prove to be correct it shows how important it is to make full inquiries before stating positively that any lake has two natural outfalls.

From the ordnance map one would imagine that two streams issued from Llyn Arenig (five miles W.N.W. of Bala), but the one shown as starting from the extreme north end of the lake has no existence in fact.

GEORGE R. JEBB

Chester, June 3

FERDINAND STOLICZKA, PH.D.

A BRIEF telegram from India, which arrived just in time for notice in last week's NATURE (vol. x. p. 172), announced the death on the 19th ult., at Shayok, between the Karakorum Pass and Leh in Ladak, of Ferdinand Stoliczka, Palæontologist to the Geological Survey of India, who was returning from Kashgar and Yarkund with the other members of Mr. Forsyth's mission.

Thus has passed away, at the early age of thirty-six, a naturalist who, if his life had been spared, would certainly have attained a very high position amongst the leaders of science. Few men have accomplished an equal amount of work in the same brief space of time. A glance at the Journal and Proceedings of the Bengal Asiatic Society, and the publications of the Geological Survey of India, especially the "Palæontologia Indica," will show the wonderful variety of subjects treated by Dr. Stoliczka. In the course of the last ten years, besides geological memoirs on parts of the Western Himalayas and Thibet, he has published numerous papers on Indian mammals, birds, reptiles, amphibia, mollusca, bryozoa, arachnida, coleoptera, and actinozoa; and these papers are no lists of names or mere descriptions of new species, but they abound with accounts of the life history of the different animals, details of their anatomy, and remarks on classification, and show that their author was as good an observer in the field as he was patient and accurate in the cabinet. His greatest work is undoubtedly his account of the fossil fauna discovered in the Cretaceous rocks of Southern India, in which he proposed the most complete general classification of Gasteropoda and Pelecypoda (Lamellibranchiata), including both fossil and recent forms, which has hitherto been attempted. This classification was largely supplemented by original anatomical research, and it has been adopted in one, at least—we believe in two—of the principal museums in Germany.

Dr. Stoliczka was born in Moravia in May 1838. After completing his university course he joined, whilst quite young, the Imperial Geological Institute of Austria, where he soon distinguished himself by his palæontological work, and became especially known for researches amongst the Bryozoa, fossil and recent. The collection of specimens belonging to that class obtained by the Novara expedition was intrusted to him for description. Amongst his principal early contributions to palæontology were papers on the fossil fauna of the Hierlatz and Gosau beds.

In 1862 he joined the Geological Survey of India, and at once commenced the study of the magnificent series of Cretaceous fossils obtained by Messrs. H. F. Blanford, C. Oldham, and the other officers of the Survey engaged in the Madras Presidency. The descriptions of these fossils have only recently been completed, and extend altogether to about 1,500 quarto pages illustrated by 178 plates. There can be no doubt of the rank of this work; it is one of the most complete monographs ever published of any fossil fauna whatever. The numerous duties connected with the post of Palæontologist to the Survey occupied so much of Dr. Stoliczka's time that he was only able to devote a few months in three different years to field-work. To this field-work we owe valuable reports on the western Himalayas, Thibet, and Kachh, the last not yet published. In the year 1868 he accepted the honorary secretaryship of the Asiatic Society, and during the five years he held the post he raised the natural history portion of the Society's journal to a position it had never approached before, this improvement being due no less to his own contributions than to the aid he was always ready to afford to all engaged in zoological inquiry.

When, last year, a mission was despatched by the Indian Government to Yarkund and Kashgar, Dr. Stoliczka was selected to accompany it as naturalist and geologist. It would have been impossible to have found anyone more competent for the post, but many of his friends knew the risk he ran, and he was well aware of it himself, for his health had been seriously affected by exposure in former years in the higher regions of the Himalayas, and he needed rest and a change to Europe. His life has been a sacrifice to the study to which he had devoted it. He was seriously ill at one time when crossing the high passes on his way to Yarkund, but recovered, and his letters from Kashgar gave glowing accounts of his discoveries, and now when returning loaded with the spoils and notes of nearly a year's research in one of the least-known parts of Central Asia he has fallen, just as his friends were in hopes of welcoming him back amongst them. This is not the place to speak of his many amiable qualities, but few men were more widely known in India or more universally beloved and esteemed, and the gap he has left in the little band of Indian naturalists and geologists, as well as amongst the far wider circle of his private friends, will be long unfilled. W. T. B.

OBSERVATORIES IN THE UNITED STATES

ONE of the most salient points in the scientific progress of America is undoubtedly the marvellous multiplication of first-class observatories during recent years. The genius of her people, the skill of her artists, and the wise liberality of states and individuals have combined to bring about a state of things which those interested in Astronomy in any country on this side of the Atlantic may regard with the intensest envy. Undoubtedly our own observatories are already distanced in everything except activity. In number, instrumental equipment, breadth of design, the American institutions are unsurpassed; and although the Americans themselves say they want men with such world-wide names as Peirce, Winlock, Newcomb, Young, Peters, and many others that we might mention, who know no resting on old laurels, it is difficult for an Englishman to acknowledge that the idea is well founded.

A very interesting and well-illustrated article on United States Observatories appears in a recent number of *Harper's Monthly*. Some of the illustrations, which we are enabled to give by the courtesy of the Editor, give a good idea of the scientific wealth to which we refer, and of the progress that has been made, for while little more than thirty years ago it could not be said that there was one astronomical observatory in the United States, to-day it is safe to place the number of all classes, public and private, beyond fifty.

Cincinnati Observatory.—One of the most strenuous advocates for the establishment of public observatories in the United States was John Quincy Adams, who had made astronomy a favourite pursuit. He had very just conceptions of what ought to be the character and aims of a true observatory. It must steadily labour for *discovery*. It must be fully equipped for this, and be provided with a *personnel* who could give their whole energies to that series of observations, running through many years, which alone can secure valuable additions to astronomical knowledge and insure its benefits to men. For the establishment of such an institution he had made his well-known appeal to Congress in 1825. He was ridiculed; but he remained as strenuous an advocate as ever for the establishment of observatories of the first class both at Washington and at Cambridge. In the very year before this address at Cincinnati he had urged, in his place in Congress, the perpetual appropriation of the whole interest of the then unappropriated Smithsonian fund for an observatory for the people.

"The express object of observatories," said he, "is the increase of knowledge by new discovery. It is to the successive discoveries of persevering astronomical observations through a period of fifty centuries that we are indebted for a permanent standard of time and for the measurement of space."

The year 1843 was, however, an era in the history of United States observatories, and Cincinnati was their birthplace. Her institution and those of Cambridge and Washington sprang up, and the enthusiasm of the era started others, whose equipment has been secured largely by their success.

As early as 1805, Cincinnati may be said to have had a practical working observatory. In that year the first Surveyor-General of the United States, Colonel Jared Mansfield, received, after a delay of at least three years in their construction and transportation from London, astronomical instruments ordered by Albert Gallatin, Secretary of the Treasury, and paid for by President Jefferson out of his *own contingent fund*, "since no appropriation for them had been made by law." The instruments, which were said to have been excellent of their kind, were a 3-foot reflecting telescope, a 30-inch portable transit instrument, and an astronomical pendulum clock. Years afterward, they were placed in the philosophical department of the Military Academy at West Point. In the house of the Surveyor-General, at Cincinnati, they were used in making numerous and interesting astronomical observations. The orbit of the comet of 1807 was calculated, eclipses of different kinds were observed, the longitude of the observatory determined, and other observations of importance made from 1807 to 1813, all of them outside of the usual duties of the mere surveyor.

Our next date is at the end of the lapse of forty years. We are brought then to the marked era in astronomical interest already referred to, and to the labours of those who awakened that interest, especially of Ormsby M‘Knight Mitchell.

Mitchell was a native of Kentucky. He graduated with honour at West Point, in 1829. Resigning from the army, and practising law in Cincinnati, he was made professor in the City College. He was an enthusiast in astronomy. He gave a series of lectures to the citizens in 1842, which created their Astronomical Society.

As the astronomer of the Society engaged for a ten-years' work, Prof. Mitchell sailed for Europe to purchase a telescope superior to any then in America. In the optical institute of Merz and Mähler, successors of the great Fraunhofer, at Munich, he found an object-glass of 12-inch aperture, which, after Lamont's test in his own tube, was pronounced superior to that of the Munich telescope. It was mounted, purchased for about 9,400 dols., and arrived in Cincinnati in 1845.

The Astronomical Society of that town meanwhile had secured from their fellow-citizen, N. Longworth, the gift of four acres of ground on one of the beautiful and commanding hills on the east of the city, and a fund of 11,000 dols. in shares of 25 dols. each.

Prof. Mitchell, on his return, devoted his whole energies to the erection of an observatory. Its corner-stone was laid November 10, 1843, on the site given by Longworth, on Mount Adams.

The observatory presented a front of eighty feet, ornamented with a Grecian Doric portico, and a depth of thirty, showing a basement and two storeys, with a central dome, covering an equatorial room twenty-five feet square, the roof being capable of entire removal when observations were to be made. The object-glass of the telescope had, as we have said, an aperture of twelve inches; its focal length was seventeen feet.

The equatorial room received the Munich instruments in March 1845. Prof. Mitchell began his labours with the enthusiasm of hope. Other necessary instruments were received: a 5-foot Troughton transit, lent by the Coast Survey, an astronomical clock, presented by Mr. M‘Grew, of Cincinnati, and a chronometer lent by Messrs. Blunt, of New York. At the request of Prof. Bache, the telegraph company connected the observatory with their stations for the determination of longitude, Cincinnati being then a central point in such work. The Astronomer Royal, under whose instruction Mitchell had passed three months in 1842, urged, in an encouraging letter, that "the first application of his meridional instruments should be for the exact determination of his geographical latitude and longitude, and that his observing energies should be given to the large equatorial." With this advice, he directed his attention largely to the remeasurement of Struve's double stars south of the equator.

Airy and Lamont had invited him to make minute observations of the satellites of Saturn, since in the latitude of Cincinnati the planet is observed at a more favourable altitude than at Pulkova, twenty degrees farther north. To these, and chiefly "to the physical association of the double, triple, and multiple suns," he gave his close attention. He made interesting discoveries in the course of this review. "Stars which Struve had marked as oblong, were divided and measured; others marked double were found to be triple." He proposed a new method for observing, and new machinery for recording north polar distances or declinations. Prof. Peirce reported favourably on this method at the meeting of the American Association in 1851, and Prof. Bache, as Superintendent of the Coast Survey, indorsed their approval in his report for that year, presenting also a full account of work done by the new method, in observations made by the enthusiastic astronomer and his patient wife, who assisted him through all. It was claimed that the results rivalled the best work done at Pulkova. Mitchell was the first "to prepare a circuit interrupter with an eight-day clock, and to use it to graduate the running fillet of paper;" and to invent and use the revolving-disk chronograph, for recording the dates of star signals. Profs. Bache and Walker had declined to adopt the first of these improvements in astronomical appliances, through an apprehension of injury to the astronomical clock. Mitchell's work proved the apprehension to be groundless. His revolving disk is an invaluable invention. To the perfection of such methods and instruments, together with the routine work of observation, he gave all the energies not of necessity employed in outside labours devolving on him for his support. Unhappily these, at an early date, became almost absorbing. For the Astronomical Society, having secured their observatory and their director, had failed to secure a basis for his support. Mitchell relied on his professorship in the Cincinnati College: in two years the college was burnt down. He then relied on publications and lectures. He published the *Sidereal Messenger*, a work of three volumes. He delivered lectures of rare power and beauty in the chief cities of the Union. He stirred up an enthusiasm by these lectures, which quickened the movements resulting in the establishment of some of the first observatories of this day in the United States. But for his support, unhappily for the observatory, he was compelled to accept the position of chief engineer of the Mississippi and Ohio Railroad from 1848-52; and finally, in 1853, that of director of the magnificent Dudley Observatory at Albany, New York. He did not, however, remove from Cincinnati till 1859. In 1861 his country claimed him from astronomy for her own service. The observatory remained in charge of Mr. Henry Twitchell, of Cincinnati, who was Mitchell's chief assistant for twelve years.

On February 1, 1869, Mr. Cleveland Abbe, formerly employed at the Pulkova Observatory, and more recently at the United States Naval Observatory at Washington, accepted the place of director. His first annual report submitted a plan of wide and useful astronomical and magnetic and geodetic investigations. On these he entered vigorously. He first adopted for the United States the issuing of daily meteorological bulletins, now so widely known as adopted and used by the United States Signal Service Bureau.

During the years since Prof. Mitchell's leaving the institution, its future had appeared dark enough. In taking charge of the Dudley Observatory in 1859 he announced his expectation that "the Cincinnati Observatory was soon to be placed on a permanent foundation, and that each observatory would be occupied on a star catalogue down to the tenth magnitude." But it is not surprising that the interval of the war should retard the plans he had formed, and prevent, under all circumstances, their subsequent execution by his successors.

But in 1870 a movement was originated by Abbe, which, at the time this article was written, promises by its development to secure results worthy of the noble founder of the observatory, and of the West. A tripartite agreement has been secured between Mr. Longworth's heirs, the Astronomical Society, and the city, by which the sale of the old site was permitted, and the city pledged to maintain the observatory in connection with the university; original investigations, and not mere educational uses being guaranteed as its object. On Mount Lookout, one of the highest points in Hamilton County, adjacent to a park not likely to be built up to the injury of astronomical observations, the corner-stone of the new observatory was laid, August 28, by the mayor of Cincinnati. The observatory is to be 71 ft. by 56 ft., with an elevation of 60 ft. It will be built of brick, trimmed with freestone. The pier of the Munich equatorial is to be of solid brick, with like capping; its height 36 ft., and its diameter 17 ft. The iron revolving turret dome adds half a storey. The meridional instruments occupy the wings.

The whole new enterprise owes its success thus far to the munificence of Mr. John Kilgour, of Cincinnati, who granted the site and a liberal grant of money. Cincinna holds that she has good ground of expectancy of success. What they need, what every observatory needs, is, first of all, an astronomer with provision for his maintenance, that he may be "free from other avocations and cares."

Fig. 1.—Ormsby McKnight Mitchell.

A true astronomer, then, first of all—before even the most imposing edifice or instruments. An astronomer with a true conception of his work, with the splendid objects before him, and the advantages of our day, may largely repay the benefactions of the liberal by the lasting benefits not of mere theory, but of the practical usefulness of discovery.

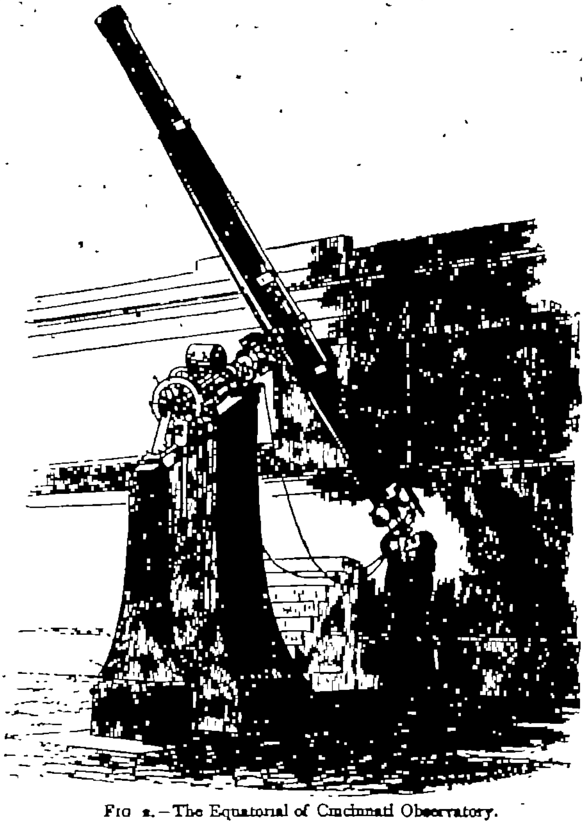


Fig. 2.—The Equatorial of Cincinnati Observatory.

The U.S. Naval Observatory.—The history of this Observatory is not a little remarkable.

Close on the isle on which stood what was known as the "Washington property," near the old Capitol, stood, in 1833, an unpretending wooden building but 16 ft. square, erected at the expense of a lieutenant of the navy, and equipped with a 5-foot Troughton transit instrument. This was the United States Naval Observatory in embryo.

The transit was one of the instruments made for the Coast Survey, under the supervision of Mr. Hassler, its first superintendent, during his long detention in England, by the breaking out of the war. Returning only in 1815, and the survey itself being soon arrested by Congress, his instruments and the "fixed observatory," the establishment of which he was the very first in the United States to propose, rested quietly *in statu quo ante bellum*. In 1832 the Coast Survey was revived; but as an observatory was peremptorily forbidden by the law, the transit was lent to Lieut. Wilkes for his observations.

Lieut. Wilkes's observations were, however, at first only for obtaining clock errors, needed for determining the true time for rating the naval chronometers then under his charge. This testing of all the chronometers and other naval instruments used by the United States ships (begun in 1830 by Lieut. Goldsborough) had been at once found a wise and useful economy for the navy. The Secretary, therefore, established this little receptacle for charts and instruments by placing an officer in charge, permitting him to build his own little observatory and do his own work. The "Depôt" was the christening then given to the establishment. This was all that Wilkes or any one of his successors dared call it even as late as 1842, when establishing the present astronomical institution.

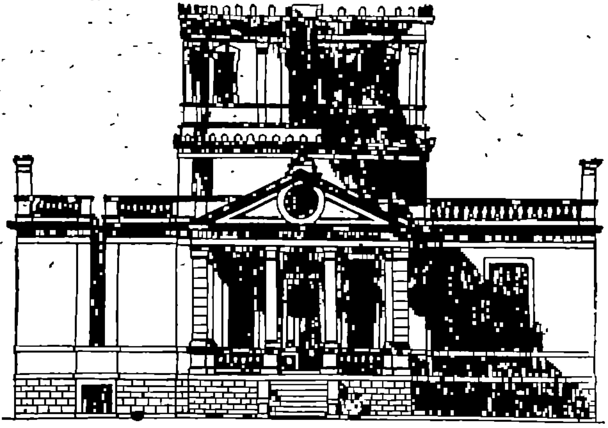


Fig. 3.—New Cincinnati Observatory—Front elevation.

But in 1838 a new call was made upon the Depôt, which turned the whole current of its future. The exploring expedition was about to sail for the South Seas. It would be of prime importance, in determining the longitude of places to be visited by the expedition, that corresponding astronomical observations should be made at home, to be compared on its return. Secretary Paulding gave the observations in the United States to Lieut. Gilliss, Wilkes's successor at the Depôt, and to Prof. Bond, of Cambridge. For the years 1838-42 Gilliss worked most accurately and unremittingly. With the help of an achromatic telescope, added by the Navy Department, and the transit before mentioned, he observed and recorded 10,000 transits; and his observations, afterwards tested by Prof. Peirce, were ranked by him among the highest then made. They are in the libraries of the astronomers of Europe. They procured, in fact, the founding of the present Naval Observatory.

For this, however, hard work in abundance was to be done. Gilliss urged the unsuitableness of his building erected alongside of Wilkes's wooden square room, and his want of space to erect a permanent circle. He won over the old Navy Commissioners and the indorsement of the Secretary to their recommendation for something better. He pressed the Naval Committees frequently and closely, but enlisted scarcely one, except Mallory, of the House. Almost to a man they kept away from the Depôt, although it was "so near," and no help seemed available. But a celestial visitant now appeared, as, singularly enough, another did in 1843 for the benefit of the Cambridge Observatory. It gained the day for Gilliss, and for an observatory at Washington. He had closely observed Encke's comet, and read a paper on it before the National Institute. When he made, shortly after this, his last intended visit to the Senate Committee, Preston of South Carolina asked, "Are you the one who gave us notice of the comet? I will do all I can to help you." In a week a bill passed the Senate; and, strangely enough, passed the House also, without discussion, on the last day of its session. It appropriated 25,000 dols.; but still "for a Depôt of Charts and Instruments."

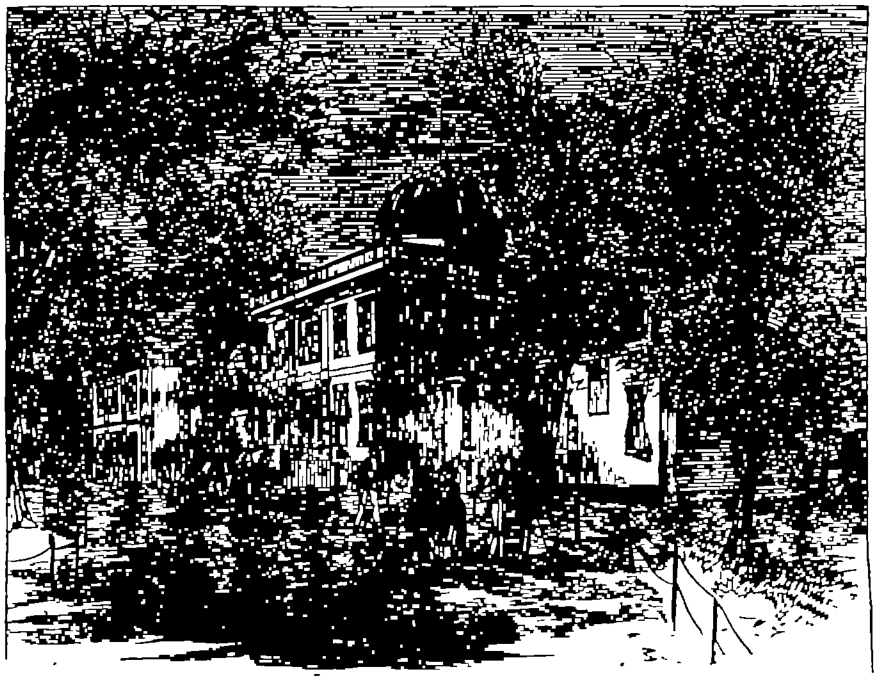


FIG. 4 —The United States Naval Observatory, Washington.

But the Secretary of the Navy was no longer officially bound by the name. The report of the committee, which secured the bill, was so expressly in favour of astronomical, meteorological, and magnetic objects, that Congress was justly understood to sanction them. Gilliss was sent abroad for instruments and plans for an observatory.

The site chosen by President Tyler for the building was fraught with historic interest. The square embraces a little more than nineteen acres in measurement. It is now tastefully laid out and ornamented. Nearly central within it stands the building represented in Fig. 4. It is on the second highest eminence within the city limits, commanding the view of the public buildings, of the neighbouring cities of Georgetown and Alexandria, and of Arlington.

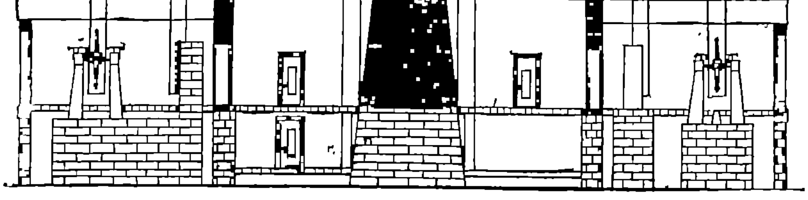


FIG. 5 —Section of Main building—United States Naval Observatory, 1844.

In 1844 Gilliss reported the completion and equipment of the central building. He had secured the excellent equatorial, the meridian circle, the transit, prime vertical, and mural circle on which so much valued work has been done. He had begun a library, to which nearly 200 volumes of the highest standard works were presented by the Greenwich, Paris, Berlin, and Vienna institutions. (*To be continued.*)

A MONUMENT TO JEREMIAH HORROCKS

At the last meeting of the Royal Astronomical Society, Prof. Adams said that he had been requested to call the attention of the Society to a petition which was about to be presented to Dean Stanley. It would speak for itself, and he would therefore read it to the meeting. It ran thus:—

To the Very Reverend the Dean of Westminster.

Reverend Sir,

It appears to us that the approaching transit of Venus offers a fitting occasion for the erection of a memorial to Jeremiah Horrocks, curate of Hoole, in Lancashire, to whom the science of astronomy is indebted for the earliest observation of Venus upon the sun's disc. He predicted, by his own calculations, the transit of the year 1639, which he and his friend Crabtree had the exclusive privilege of witnessing. The labours of Horrocks in connection with this memorable occurrence, as well as the originality of his views on other astronomical subjects, have, by the unanimous consent of scientific men, assigned to him a high place in the roll of illustrious astronomers who adorned Europe in the seventeenth century.

We therefore venture to request your permission to place in Westminster Abbey a tablet or some other memorial of Jeremiah Horrocks.

We have the honour to be,
Reverend Sir,
Your obedient Servants,

(Signed) by the Astronomer-Royal, the President of the Royal Astronomical Society, and a number of the most distinguished Fellows of the Society.

Prof. Adams remarked that he need not say anything further to recommend the signature of the memorial to the Fellows of the Society. It was perfectly impossible to estimate too highly the credit due to Horrocks, especially when his age and opportunities were taken into account. Not merely had he been successful in observing the transit of 1639, but he had first corrected the tables of Venus, from his own observations, and had thereby rendered his prediction of the transit possible. Had he merely followed the tables which had been published by Kepler, he could not have predicted the transit, and it would probably have slipped by unobserved. And this was by no means the only astronomical service rendered by Horrocks. His discovery of the law of libration of the moon's apogee constituted an important advance in the knowledge of the lunar motions. In fact, Sir Isaac Newton, when nearly half a century afterwards he attempted to explain those motions on mechanical principles, could not find any more convenient representation of the motion of the moon's apse than that which had been given by Horrocks. He had, therefore, great pleasure in bringing this petition to the notice of the Fellows of the Society.

FRENCH PREPARATIONS FOR THE TRANSIT OF VENUS

At the meeting of the French Academy of June 29, M. Dumas gave in the Report of the Commission charged with making the necessary preparations for observing the approaching transit of Venus.

The stations chosen by the commission are Campbell and St. Paul Islands, Houméa, Pekin, Yokohama and Saïgon. Each expedition is under the charge of a chief, the conduct of the first having been intrusted to M. Bouquet de la Grye, the second to M. Mouchez, the third to M. André, the fourth to M. Fleuriel, the fifth to M. Janssen, and the sixth to M. Hérault. The observers altogether number twenty-five, accompanied by twenty-five assistants. M. Bouquet de la Grye has already left; M. Fleuriel is on the point of setting out for Pekin. M. Janssen loses no time in leaving for Yokohama, from which he will not return directly to Europe, having undertaken to go to Siam to observe the eclipse which will be visible there.

As Campbell and St. Paul Islands are perfectly barren, the expeditions destined for them have been specially cared for, being furnished with fuel and provisions for six months.

A sum of 300,000 francs was allotted by the State for the whole of the expeditions; but this sum having been found insufficient, the Minister of Marine has abundantly and generously provided for the wants which have been pointed out by the Commission. Indeed, the French Government has acted in the most handsome manner towards the various expeditions, which have been furnished with everything that is in any way necessary.

As to instruments, besides those which have been specially constructed for the enterprise, the depôt of Marine has placed at the disposal of the expeditions a large number of instruments, among which are thirty-one tested chronometers. Four of the expeditions have each received an equatoreal of 8 in. No expedition from any other country, the Report states, will be possessed of instruments so powerful. Equatoreals of 6 in. have been furnished to the six expeditions, and telescopes of the same power as those adopted by the various expeditions of other countries.

Various photographic apparatus and methods of observation have been proposed. The Commission has decided in favour of the system of M. Fizeau, who has himself superintended the construction of instruments and initiated the operators in all the practical details which they ought to follow.

ON VAPORISING METALS BY ELECTRICITY

The following simple results obtained by frictional electricity may be of interest, perhaps too of use in the investigation of certain minerals and the action of intense heat upon them.

The description of a characteristic experiment is all that will be necessary to explain the process and to show how similar results may be obtained from other substances. A very fine thread of sheet platinum, of about an inch in length, is placed between two microscopic slides of glass, and two pieces of thin sheet copper with rounded ends are placed in contact with the extremities of the platinum, the copper being any convenient length and breadth, so as to extend beyond the glass slides, but not to be as broad; a charge of electricity from about eight square feet of Leyden jar is passed through the metals; the effect of the heat from the charge is to vaporise the platinum, which is instantly condensed in a transparent layer upon the cold glass. The layer can be investigated by a microscope, and employed in various ways to determine the character of the metal and its effect upon reflected or transmitted light.

Copper, tinfoil, tinfoil amalgamated with mercury, gold and silver, can be used in a similar manner, but they produce layers very dissimilar in appearance. To act upon finely-ground substances, such as vermilion, sulphate of antimony, sulphur, &c., a line of the powder must be made and the charge be passed through in the same way as through the platinum.

Part of the vapour escapes from between the slides, but this can easily be condensed upon each of two pieces of glass placed in such a way as to intercept the vapour as it passes from between the two slides; it is then condensed in a long but narrow line. The manner in which the glass is affected by the heat, and the concussion produced by the expansion of the vapour, are worthy of notice.

Considerable difficulty will be found in vaporising copper, doubtless from its being such an excellent conductor. Some of the powdered substances appear to require a small spark to be passed through them before they allow a larger charge to pass, as if the particles needed polarisation.

G. H. HOPKINS

THE HERPETOLOGY OF NEW GUINEA*

DR. ADOLF BERNHARD MEYER, who, as most of the readers of NATURE will be aware, has lately returned from a very successful expedition to New Guinea, has published in the "Monatsberichte" of the Berlin Academy a short account of his herpetological discoveries, which present several points of interest. Previous investigators of the natural history of this wonderful land have paid more attention to its birds than to its reptiles and amphibians—a circumstance perhaps scarcely to be wondered at in the land of paradise-birds and so many other anomalous forms. Dr. Meyer, however, while he has by no means neglected the class of birds, as shown by his recent communications upon that branch of zoology to the Academy of Vienna, has likewise paid much attention to the representatives of the inferior orders of reptiles and batrachians which he met with in New Guinea and the adjacent islands. Although this branch of the Papuan fauna is well known to be comparatively poor, Dr. Meyer's labours have been by no means without result. Of sixty-three different forms belonging to these orders of which he collected specimens, thirty-four have turned out to be new to science; and of the remaining twenty-nine, the greater part were previously not known to occur in this locality.

Of tortoises, besides the marine *Chelone imbricata*, only one was obtained in New Guinea, which, however, was of a new species belonging to an Australian form. Of lizards, upwards of thirty species were collected, amongst which Australian types are again predominant. Amongst the sixteen serpents met with in New Guinea, Jobi, and Mysore, were several of special interest. The Australian carpet snake, *Morelia*, is represented by an allied form, proposed to be called *Chondropython*, besides which two other new genera are described, one belonging to the boas, and the other to the colubrine snakes

Of batrachians, Dr. Meyer collected specimens of nine species in New Guinea and its islands, five of which he considers to be hitherto undescribed.

It will be thus evident that Dr. Meyer has made a by no means inconsiderable addition to our knowledge of this branch of the Papuan fauna. At the same time it cannot be supposed that we are, as yet, by any means perfectly acquainted with the herpetology of New Guinea when so little is known of the vast interior of this strange country.

COGGIA'S COMET

AN observation taken here on July 4, shows so close an agreement with the position calculated from my parabolic elements in NATURE (vol. x. p. 149), that it appears unlikely the comet can have so short a period as 137 years, and consequently that, notwithstanding similarity of orbits, it probably is not identical with the body observed by the French Jesuits in China in July 1737. Between April 17, the date of discovery, and July 4 it had traversed an arc of just 90° of true anomaly, and if any decided ellipticity existed, so wide an arc must have shown it, the stellar appearance of the nucleus having admitted of very exact observation throughout. On July 4, twenty-one days after the last position I employed in determining the orbit, the computed right ascension differs only 20″, and the declination 14″ from the observation. In all probability, therefore, the comet has not visited these parts of space within many centuries.

Measures of the diameter of the nucleus on July 4 gave nearly 14 seconds of arc, the distance of the comet at the time, by my elements, being 0·6016, which indicates a real diameter of about 3,750 miles; it has, perhaps, slightly contracted within the last fortnight.

This morning Mr. W. Plummer, at this observatory, found the comet equal in brightness to α Persei, a second magnitude star in Argelander's Atlas.

I may here mention that for calculation of actual dimensions or distances I take the sun's parallax, after M. Leverrier = 8″·86, which, combined with Capt. A. R. Clarke's value of the earth's equatorial semi-diameter, gives for the mean distance of the earth from the sun, 92,268,000 miles, a figure that I believe to be as probable as any now to be attained. The moon's mean distance from the earth, adopting Prof. J. C. Adams's parallax, is thus found to be 238,800 miles, or 60·273 equatorial radii of our globe.

J. R. HIND

Mr. Bishop's Observatory,
Twickenham, July 7

DE CANDOLLE'S PROPOSED "PHYSIOLOGICAL GROUPS" OF PLANTS

IN the *Archives des Sciences Physiques et Naturelles*, No. 197, M. de Candolle proposes a new classification of the vegetable kingdom, based on the physiological relations of plants to heat and moisture, which he believes affords a means of tracing the connections of recent and fossil floras in a way which neither botanical nor geographical grouping do. He makes six divisions altogether.

1. The first of his "physiological groups" consists of those which need much heat and much moisture, and to them he gives the name Hydromegatherm, or, for short, Megatherm. These at present live in the tropics, and sometimes as far as 30° N. and S., in warm and damp valleys, where the temperature is never below 20° C., and the rains never fail. The predecessors of the existing Megatherms were widely spread, but at the commencement of the Tertiary period they became confined pretty much to the equatorial zone. Their botanical characters vary considerably, and they are represented in almost all cases by different species in Asia, Africa, and America. The most characteristic families are Menispermaceæ, Byttneriaceæ, Ternstrœmiaceæ, Guttiferæ, Sapindaceæ, Dipterocarpeæ, Sapotaceæ, Apocinaceæ, Aristolochaceæ, Begoniaceæ, Piperaceæ, &c.

2. His second group requires heat with dryness—Xerophiles he proposes to call them. Their present distribution is in dry and warm regions of from 20° or 25° to 30° or 35° on each side of the equator (their particular districts are carefully noted). The group includes a large proportion of Compositæ, Labiatæ, Boraginaceæ, Liliaceæ, Palmæ, Myrtaceæ, Asclepiadaceæ, Euphorbiaceæ; but the most characteristic are Cactaceæ, Ficoideæ, Cycadaceæ, Proteaceæ, and Zygophylleæ. There are few large trees, few annuals, and the aspect of vegetation is but meagre. The palæontology of the regions where Xerophiles now exist is too little known for us to be able to trace the former migrations of plants forming this group.

3. The third group includes those plants which require a moderate heat, 15° to 20° C., and moderate moisture, and are named Mesotherms. They are now found around the Mediterranean, in the slightly elevated regions of India, of China, Japan, California, Central United States,

---

* "Uebersicht der von mir auf Neu Guinea, und den Inseln Jobi, Mysore, und Mafoor im Jahre 1873, gesammelten Amphibien." Von Dr. Adolf Bernhard Meyer. (Berlin: Monatsb. Akad., 1874)

the Azores, and Madeira, and in the plains and low valleys of Chili, Monte Video, Tasmania, and New Zealand. Their characteristic families are the Laurineæ, Juglandeæ, Ebenaceæ, Myricaceæ, Magnoliaceæ, Aceraceæ, Hippocastaneæ, Campanulaceæ, Cistiaceæ, Philadelphiniæ, Hypericaceæ, mixed however with a large number of Leguminosæ, Compositæ, Cupuliferæ, Labiatæ, &c.

4. The fourth group is of plants of temperate climates having annual means of 14° to 0° C., and these are named Microtherms. In Europe they occupy plains from the Cevennes and Alps to the North Cape, in Asia from the Caucasus or Himalaya, to 65°, in America from 38° or 40°, to 60° or 65°. They are also met with in Kerguelen, Campbell, and the Malonine Islands, and the mountains of New Zealand. No characteristic families are enumerated, as it is the absence of forms that are usually Mesotherms and above all of Megatherms or Xerophiles, which distinguishes this group.

5. The fifth group is of plants living in arctic or antarctic regions, or high on mountains in temperate regions. They need but little heat, and hence are called Hekistotherms. One of their important characteristics is that they can endure the absence of light during the time they are covered with snow. Though no family belongs entirely to this group, Mosses, Lichens, Grasses, Crucifers, Saxifrages, Roses, and Composites bear a large proportion to the whole. Some species of Betula, Salix, Empetrum, Vaccinium, and certain Conifers also are Hekistotherm.

6. The sixth group includes exceptional plants; those requiring a mean annual temperature of more than 30° C., for which the name Megistotherm is proposed.

After the description of his proposed groups, M. de Candolle at once faces an objection he sees is sure to be raised, and that is the difficulty of classing a species under any one particular group. His reply is that it is always possible to do so if due attention is paid to the conditions under which it lives, both by studying the climatal conditions of its native country, and by experimental culture. Fossil plants, he admits, can only be classed by analogy; but he very justly adds that in determining their botanic affinities in like manner there is generally nothing but analogy to rely on, flowers and fruits being wanting. In answer to the possible objection that there are transitions from one group to another, and that the limits are arbitrary, he is content to reply that though a classification based on botanical characters may be more precise, the limits of geographical groups and of geological periods are equally wanting in exactness.

The fact that his physiological groups in no way coincide with established botanical or geographical groups is worth notice. All families that are at all numerous in species are represented in more than one of these physiological groups, and sometimes in them all. To give only one instance, the Primulaceæ live in almost all cold and temperate regions, and yet the Myrsineaceæ, which are their woody representatives, are found in the tropics. Even in genera which have not many varieties of form, the same is the case. The Cassias, for example, are mostly Megatherms or Mesotherms, yet *Cassia marylandica* flourishes at Geneva, where the winter minimum is sometimes 25° C. Some willows flourish far north, yet *Salix humboltiana* is met with in the district of the Amazon, and *Salix safsaf* grows in Egypt.

Is there any connection between the physiological properties of plants and the form of their organs of vegetation? M. de Candollé thinks not. For example: there is no recognisable difference between the forms and tissues of ferns which we have to preserve in hot-houses and those which will grow in the open air. There are many facts such as these which seem to show that there is no direct relation of cause and effect between the form and those physiological qualities of plants which have reference to climatal conditions. There is rather a dependence on some common cause which has influenced both sets of phenomena, which M. de Candolle refers to heredity. A species has a particular form because its ancestors had a form more or less the same. It has certain physiological qualities with reference to climate because the exterior conditions which have been imposed on it through innumerable ages have prevented other qualities from being developed and have secured the heredity of those which have enabled it to live. This, he considers, is the key to the explanation why a flora of any particular climate does not present in the totality of its species any distinctive peculiarities. Arctico-Alpine plants are of different families, and it is impossible to point to any development of an organ which cannot also be met with in tropical plants. The ascendants of Arctico-Alpine plants have lived together, and only certain of them have lived together through changes of temperature. Physiological qualities may be changed in length of time when exterior conditions have not changed in such a way as to cause a species to perish. M. de Candolle lays great stress on the fact we learn from the experience of horticulturists, that it is much more rare to obtain any change in the power of a plant to endure modifications of climate than it is to obtain change of form. A period of greater length than the historic period of Europe seems to be needed for a modification of physiological conditions; witness the fact that for some 3,000 years the date has been grown in Greece and Italy without any success in getting the fruit to ripen. The fact that physiological conditions are so much more permanent than form is to M. de Candolle a strong argument in favour of his physiological groups. The impossibility of making geographical groups perfectly true, together with the fact that the climates of each region have changed from one period to another, is also claimed as additional argument in favour.

For the purpose of showing that these groups make the facts of geographical botany, both of geological and present times, more precise and more easy of discussion as regards general laws, their distribution in Europe since the commencement of the Tertiary period is taken as an illustration. The works of Gœppert, Heer, Unger, Garovaglio, Ch. T. Gaudin, Saporta, &c., have supplied M. de Candolle with his data, and on comparing the fossil floras with recent forms he has had no difficulty in classifying them according to his groups. He, of course, goes on the hypothesis that like forms have sprung from like antecedents possessing like hereditary physiological properties. As an illustration that any uncertainty there may be is within limits, he points out that though a fossil Ficus might be taken for a Megatherm or Mesotherm, it could never be mistaken for a Microtherm or Hekistotherm, since we do not now know any Ficus capable of resisting such cold. A fossil Betula may have been Microtherm or Hekistotherm, but not Megatherm.

Acting on these hypotheses he has reduced his results to tabular form, prefacing the remark that his great difficulty has been to class the different fossil floras according to geological periods that could be relied on; stratification and not palæontology being the only safe basis of relative age grouping.

Different climates prevailed in different parts of Europe during the Tertiary period as well as now, and he urges it must be recollected that when two fossil floras (faunas equally so) which are much alike are met with in widely separated latitudes, they cannot have been contemporaneous. In the same latitude, too, difference of elevation will have had a similar effect to difference of latitude. Floras of quite different facies may therefore have been contemporaneous.

In transcribing the following table and explanations we have given only the name of the author who has described the floras. M. de Candolle gives exact references to the works where the descriptions may be found.

Distribution of Physiological Groups in Europe since the Commencement of the Tertiary Period according to our present knowledge of Existing and Fossil Floras

Lat. N.	TERTIARY						QUATERNARY		Lat. N.
	Eocene			Miocene		Pliocene	Glacial	Recent	
	Lower	Middle	Upper	Lower	Upper				
90°									90°
								E	
85									85
								E	
80									80
				? C^{13}+D^4			? E^4	E	
75									75
								E	
70									70
				C^{14}+D^5				D	
65									65
								D	
60									60
							E^1	D	
55									55
	A^6			C^9			D^3 E^2	D^1 D	
50									50
	A^5+C^{12}	? A^4 A^3+C^{11}		A^1+C^8	C^6 C^7	C^2	D^2 E^3	D	
45									45
			A^2+C^{10}	C^5	C^4		C^1	C+B	
40									40
								C+B	
35									35
						? C^3		B	
30									30
								B	
25									25
								B A	
20									20
								A	
15									15
								A	
10									10
								A	
5									5
								A	
0									0

EXPLANATION OF THE TABLE

A.—*Megatherms.*

A. Existing Megatherms.
A^1. Beds of Monod, Paudeze (Heer). Mesotherms are mixed with Megatherms.
A^2. "Gypses d'Aix." Megatherms with Mesotherms C^{10}.
A^3. Chiavone and Salcedo (Massalongo). Mesotherms are mixed with Megatherms but the former are in large proportion.
A^4. "Sables supérieurs du Soissonnais" (Watelet), containing a large proportion of Megatherms. The stratigraphical position of these beds, it should be noted, is inferred from palæontological evidence rather than from superposition.
A^5. Bolca (Massalongo), although mixed with Mesotherms, Megatherms preponderate.
A^6. Sheppy (Bowerbank, Ad. Brongniart, Lyell).

B.—*Existing Xerophiles.*

The countries where fossil floras of this character are to be expected have not been worked geologically, and no bed containing Xerophiles is known.

C.—*Mesotherms.*

C. Existing and recent Mesotherms.
C^1. Many floras in the south-east of France worked out by Saporta.
C^2. Meximieux (Saporta).
C^3. S. Jorge, Madeira (Heer).
C^4 and C^5. South-east of France (Saporta). Some Megatherms occur in his lists, but they do not form a fourth part of each flora.
C^6. Piedmont (Sismonda).
C^7. Œningen (Heer).
C^8. Monod, Paudeze (see A^1).
C^9. Dantzig (Heer). The lower bed contains Sequoid, Smilax, Myrica, Ficus, Lauraceæ, Juglandaceæ, &c.
C^{10}. "Gypses d'Aix" (see A^2).
C^{11}. Chiavone and Salcedo (see A^3).
C^{12}. Bolca (see A^5).
C^{13}. Spitzbergen (Heer), mixed with Microtherms D^4.
C^{14}. Iceland (Heer), mixed with Microtherms D^5.

D.—*Microtherms.*

D. Existing and recent Microtherms.
D^1. Cannstadt alluvial deposits.
D^2. Laminated lignites of Dürnten (Heer).
D^3. Cromer forest bed (Lyell, Heer).
D^4. Spitzbergen (Heer), mixed with C^{13}.
D^5. Iceland (Heer), mixed with C^{14}.

E.—*Hekistotherms.*

E. Existing Hekistotherms.
E^1. Southern Sweden, Denmark (Nathorst).
E^2. Mecklenburg and Cromer below the forest bed (Nathorst).
E^3 Glacial clay of Schwerzenbach—between Zurich and Constance—(Nathorst).
E^4. Superficial diluvium of Spitzbergen (Heer).

Signs.

+ When two groups are united by the plus sign it means that at least one-fourth of the flora is made up of the second group indicated.
? The note of interrogation is used to imply that the geological age of the bed is doubtful.

Setting out with the belief that at a most remote period there was all over the globe a high and nearly uniform temperature, followed by a gradual cooling and the development of diversities in climates M. de Candolle proceeds to show that the earliest plants must have been Megistotherm. With the exception of the carboniferous, we are too imperfectly acquainted with the floras of Primary and Secondary periods to trace their distribution. At the commencement of the Tertiary period Megatherms occupied all the then land surfaces up to 58°. The other groups became gradually separated, and migrated as increase of cold drove them from their former areas. The means by which this was effected is a matter of hypothesis, but it is not hypothesis to say that the various groups never sprung from a single group. It cannot be proved that there formerly existed a single form of vegetation, while M. de Candolle urges that the surface of the globe certainly had formerly one uniform climate. The distribution of physiological groups indicates two sorts of floras, one migratory, the other fixed. Intertropical floras have had but few vicissitudes, arctic and antarctic have experienced many.

We submit this *résumé* of M. de Candolle's proposal and illustration without at present offering any remarks.

NOTES

The usual programme of the forthcoming (the 44th) meeting of the British Association at Belfast has been issued. The First General Meeting will be held on Wednesday, Aug. 19, at 8 A.M. precisely, when Prof. Williamson, F.R.S., will resign the chair, and Prof. Tyndall, F.R.S., President-elect, will assume the presidency, and deliver an address. On Thursday evening, Aug. 20, at 8 P.M., there will be a Soirée; on Friday evening, Aug. 21, at 8 P.M., a Discourse by Prof. Huxley, F.R.S.; on Monday evening, Aug. 24, at 8.30 P.M., a Discourse by Sir John Lubbock, Bart., M.P., F.R.S.; on Tuesday evening, Aug. 25, at 8 P.M., a Soirée; on Wednesday, Aug. 26, the concluding General Meeting will be held at 2.30 P.M. The following are the officials of the various sections:—A, Mathematical and Physical Science.—President: Rev. Prof. J. H. Jellett, M.R.I.A. Vice-Presidents: Prof. Everett, F.R.S.E.; Prof. Purser, M.R.I.A. Secretaries: Prof. W. K. Clifford, F.R.S.; J. W. L. Glaisher, F.R.A.S.; Prof. Herschel, F.R.A.S.; Randal Nixon; G. F. Rodwell, F.R.A.S. B, Chemical Science.—President: Prof. A. Crum Brown, F.R.S.E. Vice-Presidents: Prof. Maxwell Simpson, F.R.S.; Dr. Debus, F.R.S. Secretaries: Dr. J. F. Hodges, F.C.S.; W. Chandler Roberts, F.C.S.; Prof. Thorpe, F.R.S.E. C, Geology.—President: Prof. Hull, F.R.S. Vice-Presidents: Prof. Harkness, F.R.S.; Prof. Geikie, F.R.S. Secretaries: Louis C. Miall; R. G. Symes. D, Biology.—President: Prof. Redfern, M.D. Vice-Presidents: Dr. Hooker, C.B., Pres. R.S.; Sir W. R. Wilde; J. Gwyn Jeffreys, F.R.S. Department of Anatomy and Physiology.—Prof. Redfern (president) will preside. Secretaries: Dr. J. J. Charles; Dr. P. H. Pye-Smith. Department of Zoology and Botany.—Dr. Hooker, C.B., Pres. R.S. (vice-president), will preside. Secretaries: Prof. W. T. Thiselton-Dyer, Prof. R. O. Cunningham, F.L.S. Department of Anthropology.—Sir W. R. Wilde (vice-president) will preside. Secretary: F. W. Rudler, F.G.S. E, Geography,—President: Major Wilson, F.R.S., Director of the Topographical Department of the Army. Vice-presidents: Sir Bartle Frere, G.C.S.I., K.C.B., F.R.G.S.; Admiral Ommanney, C.B., F.R.S.; Major-General Strachey, F.R.S.; Secretaries: E. G. Ravenstein, F.R.G.S.; E. C. Rye; J. H. Thomas, F.R.G.S. F, Economic Science and Statistics.—President:——. Vice-presidents: W. Donnelly, C.B.; Prof. T. E. Cliffe Leslie. Secretaries: F. P. Fellowes, F.S.A.; E. Macrory. G, Mechanical Science.—President: Prof. James Thomson, F.R.S.E. Vice-presidents: Sir John Hawkshaw, F.R.S.; Sir Charles Lanyon. Secretaries: James Barton; E. H. Carbutt; J. N. Shoolbred, F.G.S.

THE announcements for holding the twenty-third meeting of the American Association for the Advancement of Science at Hartford, Connecticut, on Aug. 12, have been issued by the secretary, in which we are informed that the head-quarters will be at the State House. Dr. John L. Leconte, of Philadelphia, is president of the coming meeting; Prof. C. S. Lyman, vice-president; F. W. Putnam, of Salem, permanent secretary; Dr. A. C. Hamlin, general secretary; and William S. Vaux, treasurer. The Hon. H. C. Robinson is chairman of the local committee.

A MARBLE *replica* of Woolner's remarkably fine bust of the late Prof. Sedgwick has just been placed in the hall of the Geological Museum in Jermyn Street, the gift of a lady who wishes to be anonymous. The School of British Geology is now well represented in this museum by the busts of the following geologists:—Hutton, Playfair, Sir James Hall, William Smith, Greenough, Buckland, De la Beche, Forbes, Murchison, and Sedgwick.

IT will be heard with regret that Dr. J. Hughes Bennett has been obliged, on account of his health, to intimate his resignation of the Chair of Physiology in the University of Edinburgh. It is understood that Dr. McKendrick, Dr. Bell Pettigrew, and Prof. Rutherford will offer themselves for the vacant chair.

PROF. SCHROEDER of Erlangen (*Deutsche Archiv fur klinische Medicin*) confirms, by a remarkable case occuring in his own practice, the previous observations of Winkel and C. Braun, of the occasional occurrence of small cysts in the mucous membrane of the vagina of pregnant females containing some kind of air. These cysts he proposes to call air-cysts. When they are opened the air escapes with a report or crack. These observations, if verified by subsequent inquirers, will form a remarkable addition to the pathology of gaseous secretion or production.

THE Observatory at Kiel, of which Dr. C. A. F. Peters is director, is to be removed to Altona, in order to be in closer connection with the University.

THE death is announced of Mr. Henry Grinnell, of New York, whom the English public will remember in connection with the Grinnell Arctic Expedition.

AT the distribution last week of prizes at King's College, Mr. W. E. Forster, M.P., gave an address in which, among other subjects, he contrasted the expense of educating a boy from the age of nine to twenty-two at the older schools and universities with the cost of education during the same period at King's College; in the former case it is between 1,600*l*. and 1,800*l*., in the latter only 400*l*. Mr. Forster also referred to the superior advantages, in some respects, of German over English schools; he might at the same time have pointed out that a German boy can obtain the best education which his country can give at a cost of something like 5*l*. a year, which for the thirteen years between nine and twenty-two amounts to the ridiculously small sum of 65*l*.

AT St. John's College, Cambridge, in April 1875, there will be offered for competition an Exhibition of 50*l*. per annum for proficiency in Natural Science, the Exhibition to be tenable for three years in case the Exhibitioner have passed within two years the Previous Examination as required for candidates for honours: otherwise the Exhibition to cease at the end of two years. The candidates for the Exhibition will have a special examination (commencing on Saturday, April 3, at 1 P.M.) in (1) Chemistry, including practical work in the laboratory; (2) Physics, viz. Electricity, Heat, Light; (3) Physiology. They will also have the opportunity of being examined in one or more of the following subjects—(4) Geology; (5) Anatomy; (6) Botany, provided that they give notice of the subjects in which they wish to be examined four weeks prior to the examination. No candidate will be examined in more than three of these six subjects, wherof one at least must be chosen from the former group. It is the wish of the master and seniors that excellence in some single department should be specially regarded by the candidates. They may also, if they think fit, offer themselves for examination in any of the Classical or Mathematical subjects. Candidates must send their names to one of the tutors fourteen days before the commencement of the examination. The Exhibition is not limited in respect to the age of candidates, and is not vacated by election to Foundation Scholarships.

THERE will be an examination at Queen's College, Cambridge, on Thursday, Oct. 8, 1874, for an Exhibition for proficiency in Natural Science, open to all persons under twenty years of age who shall not have commenced residence in the University. The Exhibition will be of the value of 40*l*. per annum. Candidates will be required to pass an examination in elementary classics and mathematics. No Exhibition will be given unless the examiners report that a candidate merits such a distinction. Each candidate must forward to the President of the College before the day of examination a certificate of birth or baptism, and a certificate of good conduct from a graduate of Cambridge, Oxford, or Dublin. The successful candidates will be required to enter their names on the boards of the College and to commence residence at once. Further particulars will be furnished by the Rev. Dr. Campion, or the Rev. G. Pirie, Tutors of the College.

The first number of a new journal, which promises to be an important organ on an important subject, appeared on Saturday last. The *Sanitary Record*, a weekly journal of public health, proposes for its object, to collect and digest information relating to the health of the people, now much scattered, and therefore in a condition much less available for reference and study than it might be. It is also to contain original papers in which sanitary points are discussed in their scientific, social, and legislative aspects; together with reviews of the British and foreign literature of the subject. The staff of contributors includes names of many who hold the highest scientific position, and who are well known as authorities on hygienic matters. Miss Octavia Hill and several other ladies are also included; a paper by Miss Beale, Principal of the Cheltenham College for Ladies, appearing in the first number, while others are promised shortly by Miss Stanley, Miss Hill, and Mrs. E. Maurice. We are convinced that this new journal will fill a gap which has existed for some time; and, from the introductory number before us, we think that no one will have reason to complain of the manner in which it has been organised and started.

Prof. O. C. Marsh, of Yale College, has directed attention, at a recent meeting of the Connecticut Academy of Arts and Sciences, to the peculiarly diminished capacity of the brain-case in some of the Tertiary mammalia of North America. This is most marked in the Eocene genus Dinoceras, an animal which must have been nearly as bulky as a full-sized elephant, and yet its brain could not have been more than one-eighth the average bulk of that in the Indian rhinoceros. In the Miocene Brontotherium the brain-case was considerably large proportionately; and in the Pliocene Mastodon bigger still. These facts have an important bearing on the evolution of mammals, and open an interesting field for further investigation.

An important addition to ornithological literature has just appeared in the form of Mr. Sharpe's "Catalogue of the Birds in the British Museum," of which the first volume, comprising the Accipitres, or Raptorial birds, is before us.

We believe that at a recent meeting of the Council of the Zoological Society it was determined that a new building, on a large and much improved scale, should be commenced next spring and completed during the summer, to contain the lions, tigers, and other large feline animals.

The Senate of the University of London, at a meeting on July 1, adopted the following amendment by 17 votes to 10 on a proposal to obtain a new charter enabling the University to confer degrees on women:—"That the Senate is desirous to extend the scope of the educational advantages now offered to women, but it is not prepared to apply for a new charter to admit women to its degrees."

The well-known German ethnologist, Dr. A. Bastian, is about to publish a work with maps and illustrations, giving the results of the German expedition to the coast of Loango.

M. Leverrier has asked for an authorisation to attend or to send a representative to the Maritime Congress, the programme of which we gave in a recent number.

The comet is beginning to attract the notice of the general public. Telescopes are let on hire in several parts of Paris to get a view of it.

The balloon of the Observatory of Paris is undergoing repairs under the superintendence of M. W. de Fonvielle. It will be used by him in making ascents in order to verify the law of barometric pressure calculated by Laplace. Trigonometrical measures will be taken of the balloon by the astronomer of the Paris Observatory. The balloon is a silk one worth 1,600*l.*, which was built during the war and was used for making captive ascents by the *armée de la Loire*. It is to be called the *Neptune*.

Scientific ascents are becoming numerous in Paris. Last Friday a balloon was sent up from La Villette gasworks to try an apparatus invented by M. Jules Godard to ascertain whether the balloon is descending or ascending. The motor of the apparatus is a large horizontal disc, which is pushed by air pressure and puts in motion an electrical signal. The contrivance is rather heavy and bulky, and the rate of motion gives no idea of the numerical value of the movement.

We take the following from the *Academy*:—"Some of the American papers state that Prof. Huxley is likely to be the successor of Prof. Agassiz, at Harvard. We hope there is no truth in this. Are the English Universities so rich in really eminent professors, and so poor in money, that they can or must allow Prof. Huxley to go to America in order to find leisure for work? It would require nothing but the will for either Oxford or Cambridge to offer Huxley two or three thousand a year, without anybody suffering for it. There are hundreds of non-resident Fellows, doing no good to the University, doing harm to themselves in resting on their oars, when they ought to be pulling with all their might. Why not give five or ten such Fellowships to men like Huxley, and make the Universities again what they were in the middle ages, the very centres of intellectual force and light in the country? The Universities are so rich that they could beggar the whole world. Will they allow themselves to be beggared by Harvard?"

The first number of the *Linguist and Educational Review*, a monthly journal devoted to language, antiquities, science, and education, has appeared; its object is the popular treatment of the various branches of ethnology, folk-lore, and kindred subjects. This first number contains an interesting article on practical education, in which the wider use of the natural sciences in schools is advocated and the disproportionate amount of time spent on the study of the classics deprecated. It also contains several other interesting articles in ethnology, &c. We gladly note that the editor intends to give a portion of space monthly to the proceedings and papers of local scientific societies.

At the General Monthly Meeting of the Royal Institution, on Monday, the Secretary reported that Lady Fellows, the widow of Sir Charles Fellows, who was long a member and frequently a manager of the Royal Institution, had bequeathed to the Institution her drawings of Sir Charles's celebrated collection of watches, bequeathed to the British Museum.

Arrangements have been concluded between the proprietors of the *Daily Telegraph* and Mr. Bennett, proprietor of the *New York Herald*, under which an expedition will at once be despatched to Africa, with the objects of investigating and reporting upon the haunts of the slave-traders, of pursuing the discoveries of Dr. Livingstone, and of completing if possible the remaining problems of Central African geography. This expedition has been undertaken by and will be under the sole command of Mr. Henry M. Stanley.

At the fortieth Annual Meeting of the Statistical Society, held on June 30, the report showed an increase of seventy-six Fellows in the year ending December 31, 1873. By consequence, the financial state of the Society is satisfactory, the surplus of assets over liabilities being 2,508*l.* Dr. Guy was re-elected president.

It was reported last week that the cable steamer *Faraday* (see Nature, vol. x. p. 64) had struck on an iceberg off Halifax and became a total wreck. Happily this rumour has been proved to be without foundation.

On Saturday last, July 4, a meeting of the Council of the Royal School of Mines was held at the Jermyn Street Museum, at which the reports of the examinations of the students connected with that institution were received and considered, and the prizes awarded. The following gentlemen received the diploma of Associate of the Royal School of Mines:—Mining, Metallurgical, and Geological Divisions, S. A. Hill and W. Saise; Mining and Metallurgical Divisions, R. Cowper, A. R. Guerard, C. Lloyd Morgan; Metallurgical Division, W. Pearce; Geological Division, A. R. Willis and W. Frecheville. The two Royal Scholarships of 15*l.* each for first year's students were awarded to Henry Louis and E. Fisher Pittman; H.R.H. the Duke of Cornwall's Scholarship was awarded to A. R. Willis, and the Royal Scholarship of 25*l.* to W. S. Lowe; the Edward Forbes Medal and prize of books were awarded to A. R. Willis; the De la Beche medal and prize of books to C. Lloyd Morgan; the Murchison Medal and prize of books to A. R. Willis.

The Quarterly Weather Report of the Meteorological Office has been issued, containing the observations of the seven observatories from April to June 1873.

The additions to the Zoological Society's Gardens during the last week include a Himalayan Bear (*Ursus tibetanus*), presented by Mr. George Lockie; two Red Kangaroos (*Macropus robustus*) from Australia, presented by the Acclimatisation Society of Melbourne; two Audouin's Gulls (*Larus audouini*) from Sardinia, presented by Lord Lilford; a Kappler's Armadillo (*Tatusia kappleri*) from Surinam, deposited; two Musquashes (*Fiber zibethicus*) from North America, received in exchange; a Harpy Eagle (*Thrasaetus harpyia*) from Paraguay; seven Ariel Toucans (*Ramphastos ariel*) from Brazil, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

SCIENTIFIC SERIALS

The current number of the *Journal of Anatomy and Physiology* contains several papers of interest. Dr. Binz commences with an article On some effects of alcohol on warm-blooded animals, in which he supports the non-heating action of alcohol, considering the subjective impression as partly the consequence of the irritation of the nerves of the stomach, and of the enlargement of the cutaneous vessels. The cooling effect of alcohol on febrile conditions is demonstrated and shown to depend on its direct diminution of the activity of the cellular elements of the body, on the increase of the cutaneous circulation which arises from strengthening of the heart's action, and in the diminution of muscular activity which follows its exhibition.—Dr. J. Blake continues his observations On the action of inorganic substances when introduced directly into the blood, endeavouring to show that in the same isomorphous group of elements, the intensity of physiological action increases as the atomic weight of the elements, but the relative atomicity of groups which are not closely related shows no corresponding gradation. The salts described on the present occasion are those of the alkaline earths.—Prof. Cleland discusses double-bodied monsters (kittens), and the development of the tongue in them, that organ being frequently found situated in the nasal passages, the palate at the same time being cleft.—Dr. C. Reyher described points connected with the cartilages and synovial membranes of joints, showing that the "synovial process," or portion of the synovial membrane which lies over the borders of the cartilages, is not to be looked upon as an ingrowth of the synovial membrane but as being formed *in situ* as the development of the joint proceeds.—Mr. Reoch endeavours to account for the presence of free hydrochloric acid in the gastric juice, the constant presence of which he gives experiments in proof of, on the far-fetched assumption that the oxidation of the sulphur which is contained in albumen takes place in the walls of the stomach; that the sulphuric acid thus formed decomposes the sodium chloride, liberating free hydrochloric acid to form part of the gastric juice.—Prof. Turner having had a second specimen of the Greenland shark (*Læmargus borealis*), is enabled to give an account of parts omitted in the original description, to be found in the same journal of the year previous. He gives a drawing of the animal, which was six feet long. It was male, and the sexual organs are described. The testes possess no vasa-deferentia, their products must therefore be shed into the peritoneal cavity, whence they reach the exterior water through the abdominal pores. The ureters were found to combine before they entered the cloaca by the single duct.—Prof. Savory has a paper On the use of the ligamentum teres of the hip-joint, in which he endeavours to prove the idea, which, as he remarks, had been previously suggested by the late Prof. Partridge and by Prof. Turner, that the body is slung on the two ligaments as a carriage is on C-springs. Prof. Humphry criticises Mr. Savory's results, restating his former remarks that the ligamentum teres is not tense in the erect posture.—Prof. Turner, in description of variations in the arrangement of the nerves of the human body, mentions a branch from the fourth cranial nerve to the orbicularis palpebrarum. In another instance the same nerve sent a branch to the infra-trochlear of the nasal. Peculiarities in the various plexuses are also noted.—A loquacious paper follows by Dr. Radcliffe on the syntheses of motion, vital and physical, in which it is attempted to be shown, that in muscle the state of rest is that of contraction; the state of action relaxation.—Mr. Ogilvie and Mr. Cathcart give the dissection of a malformed lamb.—Prof. Crum-Brown gives an ingenious explanation of the sense of rotation and its connection with the semicircular canals, connecting it with the inertia of their contents affecting the peripheral ends of the auditory nerves.—Dr. Brunton proves the value of external warmth in preventing death from an over-dose of chloral.—Mr. F. Champneys gives a detailed description of the septum of the auricles of the frog and the rabbit.—Mr. J. C. Ewart describes the epithelium in front of the retina and the external surface of the lens.—Dr. J. Ogle describes and figures a man born without legs.—Prof. Turner gives a drawing of the surface of the brain in its relation to the skull, which is followed by part of his paper on the placentation of the sloths, which we have noticed on a former occasion.—Notes on some muscular irregularities follow, by Prof. Curnow; and the papers of the number end with three short notes by Mr. G. J. M. Smith, Mr. J. A. Russell, and Mr. Bellamy, on the dissection of an excised elbow, on unusually large renal calculus, three inches long, and a fusion of some of the carpal bones, repectively.

Bulletin Mensuel de la Société d'Acclimatation de Paris.—In his anniversary speech, reported in the Bulletin for April, M. Drouyn de Lhuys, the president, gives an interesting account of the victories of acclimatisation in the case of the coffee plant, the product of which, now universally esteemed, would never have been general but for its transplantation from its native home, Abyssinia, into other parts of Africa, into Europe, Asia, America, and those East and West Indian Islands which are now its best producers.—M. H. Bouley follows with an exhaustive paper on the subjection of animals by man to his own purposes. He analyses the various effects of food, of climate, of locality, of selection, and other influences on the natures of animals, and shows how our principal useful animals, such as the horse and the dog, have gradually, by dint of the constant exertion of various powers, been brought to their present state of subjection.—The annual report of the Society gives a retrospective glance at the year's work. Among birds the principal acquisitions have been varieties of pheasants, black swans, and Chilian geese. Among fishes, the telescope fish, the rainbow fish of China, and the *gourami*, are the most remarkable. Among plants, numerous Australian trees, acacias, and others; various kinds of bamboos; the *Eucalyptus*, fairly acclimatised in Algeria; and China grass, which promises to form a useful textile fabric, have been introduced.

Zeitschrift für Ethnologie.—Recent numbers of the *Zeitschrift fur Ethnologie* have been continuing and concluding the series of papers in which its readers have been put in possession of a very minute summary of Col. Dalton's official report on the ethnology of Bengal, translated by Herr Oscar Flex, missionary in Ranchi. These valuable reports proclaim the remarkable dissimilarity which prevails in the domestic habits and national customs of tribes presenting strong linguistic and psychical affinity with one another. Thus amongst the Manipuris, who may possibly, however, be of Aryan descent, although they have long been followers of the religion of Brahma, and claimed him for their proto-genitor, the women enjoy perfect freedom, both in regard to their control of the household and their participation in games in which men take part; and although the husband may divorce his wife on good grounds, if he ventures to do so without valid reason the woman may leave him and appropriate to herself all his possessions, with the exception of a cup and his loin-cloth. These people also celebrate feasts at which meat is partaken of, contrary to the proscriptions of their present form of religion. Among the neighbouring Kukis no such practices prevail, the men drinking and smoking apart in their festive gatherings, and celebrating solemn festivals by visiting the graves of their forefathers to consult oracles and seek for omens. In the country of the Kasias, where Lieut. Bedingfield was murdered two years after its annexation to our Indian empire, monoliths and other stone memorials are common, and for the most part present great similarity to the menhirs and cromlechs of Cornwall and Brittany. The Garos, whose country lies west of Kasia and extends in the south and east as far as the Brahmaputra, are but little known beyond their own frontiers, while the mountainous districts of their settlements continue to be almost wholly unexplored. These tribes claim to be a primitive people, while, like the Brits, they pretend to have affinity with the English races.—Dr. J. G. Wetzstein gives an interesting account of the ancient Hebrew threshing board, still in use in Syria, where every village has its communal threshing ground to which the neighbouring landowners—both great proprietors and the small peasants—bring their grain, mostly on camels, to be prepared on these curious tables or boards. Dr. Wetzstein has laid before the Anthropological Society of Berlin a sample of the stones in use for this simple mechanical contrivance, which appears to be almost unchanged in its structure and mode of use from Biblical times to the present day, and may be seen amongst the Berbers, the Cypriots, and in other parts of Asia Minor, besides Syria.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—On the Employment of a Planimeter to obtain Mean Values from the traces of continuous Self-recording Meteorological Instruments, by Robert H. Scott, F.R.S.

The usual method of dealing with barograms and thermograms is to measure them at certain intervals by appropriate scales, and to treat the numerical values so obtained by arithmetical processes so as to arrive at mean results.

At the suggestion of Mr. Francis Galton, the Meteorological Committee gave instructions that measurements should be made of the curves by means of Amsler's Planimeter, in order to test the accuracy of unpublished means.

It is perfectly obvious that the measurement of the area of the curve, if it can be executed with sufficient accuracy, must give a far more satisfactory mode of ascertaining the value of the mean ordinate of the curve, than the calculation of the average of any number of measured individual ordinates, while the economy of time insured by the use of the planimeter forms a most important recommendation for its use.

The mode of employing the instrument is as follows:—The entire perimeter of the curve, down to the base line, is measured, and the value noted. Then *using the same base line*, a rectangle of known height, in units of the scale of the curve, is next measured in the same way, and the value noted again.

The ratio of these two values is the mean value of the ordinate of the curve, or the mean pressure or temperature for the interval embraced by the curve.

The table subjoined to the paper shows for a period of eight months the means of temperature for Kew Observatory obtained by the planimeter, as well as those yielded by the old method, both for daily and for five-day means. It will be seen that the difference in 242 determinations of daily means only amounted to 0°·5 on six occasions, and to 0°·6 in one instance, while out of 49 cases of five-day means the greatest difference was only 0°·4, and this was only once attained.

At the end of the table a column headed "Wr. Rep. Plates" gives the values obtained by measurement of the plates published in the "Quarterly Weather Report" for the period embraced by the measurements to which I have just alluded. It will be seen from it that the five-day means so obtained hardly differ from those which are yielded by the direct measurement of the photographic curve by means of the planimeter.

The plates in question are obtained by the use of Mr. Francis Galton's Pantagraph, which transfers the seconds at a reduced time-scale to zinc plates, which plates are subsequently further reduced and transferred to copper by Wagner's Pantagraph, as explained in the report of the Committee for 1870.

Such a test as this affords a satisfactory proof of the accuracy of the reproduction of our automatic records which are executed in the Meteorological Office.

The result of these preliminary experiments is that the planimeter means are practically identical with those obtained by treatment of the values of the hourly ordinates.

On the diuretic action of *Digitalis*, by T. Lauder Brunton, M.D., and Henry Power, M.B.

The object of this communication is to show that the diuretic effects which follow the exhibition of digitalis depend on the reactionary relaxation which follows the spasm of the smaller renal arteries consequent on the influence of the digitalis, instead of on the direct increase in the arterial blood-pressure, the direct effect of the drug.

An account of certain Organisms occurring in the Blood, by W. Osler, M.D.

In many diseased conditions, and sometimes in health, careful investigation of the blood proves that, in addition to the usual elements, there exist pale granular masses, which on closer inspection present a corpuscular appearance, varying in size from a quarter that of a white blood-corpuscle to enormous masses, with an oval or rounded form, sometimes elongate or irregular. The author watches these bodies at a temperature of 37° C and finds that they undergo remarkable changes At first uniform and still, Brownian movements soon commence; fine projections from the mass develop; its edges become less dense, more loosely arranged; semi-free minor corpuscles form, which quickly break away, moving independently in the fluid. Other filaments undergo the same change, fresh detachments becoming so numerous as to fill the field of the object glass. Granules present themselves in abundance. The original mass has now become perceptibly smaller and more granular. The variety of the forms increases as the development goes on; and whereas at first spermatozoa-like or spindle-shaped forms were almost exclusively to be seen, more irregular forms appear later, possessing two, three, or more tail-like processes. It is to be noted that in blood without the addition of saline solution or serum, no change takes place in the corpuscles under consideration, even after prolonged warming. It must still be confessed that we know nothing of the origin or destiny of these corpuscles; they evidently cannot arise from the disintegration of white corpuscles, for they form individual elements circulating through the blood.

On Coniferine and its Conversion into the Aromatic Principle of Vanilla, by Ferd. Tiemann and Wilh. Haarmann. Communicated by A. W. Hoffmann, F.R.S.

Given the number of figures (not exceeding 100) in the reciprocal of a prime number, to determine the prime itself, by William Shanks. Communicated by the Rev. G. Salmon, F.R.S.

Description of the living and extinct races of gigantic Land Tortoises. Part I. and II. Introduction, and the Tortoises of the Galapagos Islands, by Albert Gunther, F.R.S.

The author having the opportunity of examining remains of tortoises from the Mascarene Islands concludes that the several extinct gigantic species are different from the more recent ones, and that there is the greatest resemblance between the tortoises of the Mascarene and Galapagos Islands. An historical account is given, which shows that the presence of these tortoises at two so distant stations cannot be accounted for by the agency of man, at least not in historic times, and therefore that these animals must be regarded as indigenous. The second part contains a description of the Galapagos tortoises.

EDINBURGH.

Scottish Meteorological Society, July 2.—This was the Half-yearly General Meeting of the Society; the Marquis of Tweeddale, president of the Society, in the chair. The report was read by Mr. Milne Home, chairman of the Council, from which it appeared that the Society's stations number at present 104, of which 92 are in Scotland, and that the Society consists of 558 ordinary, 15 corresponding, and 8 honorary members Observations are made at fourteen stations in Scotland at 12 43 P.M., in connection with the *International* scheme of Meteorology. The Hon. B. Primrose, secretary of the Fishery Board, who had entered with much zeal into the inquiry into the relations of meteorology to the herring fishery, having intimated that if the Society would furnish the necessary instruments he would endeavour that twenty sets of observations of sea temperature should be carried on during the fishing season, the Marquis of Tweeddale has liberally provided the instruments required. Dr. Arthur Mitchell stated that the Ozone Committee had resolved publicly to invite investigators to submit to them any scheme which in their opinion would increase our knowledge of ozone, and which they were desirous to prosecute if assented. It is hoped that some line of inquiry likely to lead to satisfactory results will soon be suggested, and whenever this is done the Committee will be prepared to give assistance out of the fund of 100*l.* placed at their disposal by the munificence of the noble President. Dr. Arthur Mitchell and Mr. Buchan read a paper on the influence of seasons on human mortality, which we hope to give next week. Mr. Ballingall, Islay, exhibited and described a new pressure anemometer, invented by him. The instrument consists of a measured surface, which, exposed to the wind, registers its force by means of an index, acted upon by a wooden plunger in a bath of mercury. Mr. Thomas Stevenson, C.E., described a portable barometer made of malleable iron, which he suggested for portable purposes. The instrument also contained an ingenious arrangement suggested to him by Mr. E. Sang. Iron will also be very suitable for water or oil barometers in which a very large scale is desirable for showing sudden changes in the atmospheric pressure, the accurate observations of which are likely to grow in importance from year to year.

BERLIN

German Chemical Society, June 8.—C. Rammelsberg, president, in the chair.—G. Langbein described the manufacture of iodide of potassium from iodide of copper, containing 60—66 per cent. of iodine, which is now largely imported from Peru. It is transformed into HI by treating it with SH_2 and then saturated with carbonate of potassium.—J. Thomsen maintains his view against that expressed by Berthelot, who believes the existence of definite hydrates of acids and alkalis to be proved by the heat of combination.—M. Nencky, by heating acetate of guanidine, has obtained a new monoatomic base, guanamine, of the formula $C_4N_5H_7$.—The same author has obtained a direct combination of oxalate of ethyl with sulpho-urea.—K. Heuman communicates observations on cinnabar. Light transforms it into the black modification, particularly when obtained by precipitation. Metallic copper at 100° separates mercury from it in the metallic state.—C. Liebermann, by treating benzoyl-benzoic acid $C_{14}H_{10}O_3$ with sulphuric acid, has transformed it into anthracen-sulphuric acid.—A. W. Hofmann has investigated residues of the aniline manufactory of M. Weiler in Cologne, consisting of pure phenylene-diamine.—K. Wippermann publishes new investigations on the condensed hydrocyanic acid $C_3N_3H_3$ lately obtained by Langé. It is always formed when hydrocyanic acid is kept with a small quantity of alkali, and then distilled. It is extracted from the residue by ether. Hydrate of baryta transforms it into glycocol. Its formula appears to be $N{\equiv}C-C(NH_2)H-C{\equiv}N$, the nitrile of amido-malonic acid.—H. Schiff assigns the formula of a dilaureate of glycerine to the fat of laurel, which has hitherto been considered as a derivative of allylic glycol.—L. Henry proves the formula of lactide to be doubly as large as has been admitted until now $= (C_3H_4O_2)_2$.—The same chemist described derivatives of propargyl C_3H_3 with Br, Br_3, and Br_5, of chloride of allyl with HBrO and of chloral with monochlorhydrin of glycol.—C. Kaiser showed a set of very exact weights cut in rock crystal and obtained from the manufactory of Hermann Stern in Oberstein, near Kreuznach.

PARIS

Academy of Sciences, June 29.—M. Bertrand in the chair.—Gen. Morin communicated to the Academy a telegraphic despatch from the Emperor of Brazil, sent from Rio de Janeiro on June 23, and received in Paris on the 24th.—The following communications were read:—On a new property of metallic rhodium, by MM. H. Sainte-Claire Deville and H. Debray. When iridium and rhodium are precipitated from their solutions by formic acid or alcohol, the finely divided metallic powders possess remarkable properties. The rhodium thus obtained decomposes alcohol (in presence of alkali) hydrogen being liberated and an acetate produced. Formic acid is decomposed by the same substance into carbon dioxide and water. Platinum and palladium in the same condition do not attack formic acid, while iridium and ruthenium act like rhodium.—M. A. Ledieu presented the concluding portion of his researches on the theory of the collision of bodies with consideration of atomic vibrations.—On the spectra of vapours at high temperatures, by Mr. J. N. Lockyer. This paper contains the results of experiments already communicated to the Royal Society and published in NATURE.—Report on the state of the preparations for the expeditions sent by the Academy to observe the transit of Venus on Dec. 9, by M. Dumas.—Report on the administrative measures to be taken for the preservation of territories threatened by *Phylloxera*, by the Commissioners. It is suggested to the Academy that a special law should be made compelling proprietors to declare the first appearance of the scourge, that experts should then be appointed to examine into the state of the infested vines, and that these should be destroyed when thought necessary by ministerial decision, the proprietor receiving adequate compensation. It is further suggested to destroy the vines surrounding the districts actually invaded, to disinfect the soil by chemical methods, and to burn the cuttings, leaves, and roots of the diseased plants as well as the plants themselves in the same district where the uprooting has taken place, and finally to prohibit with the utmost rigour the exportation from infested territories of anything that might serve as a vehicle for the insect.—M. Heis communicated a letter sent by him to M. Faye concerning the studies recommended to the observers of the forthcoming transit of Venus. The author suggests the observation of meteors and the zodiacal light with respect to colour, intensity, form, &c.; also of the milky way and of polar auroras.—On the temperature of the sun, by M. J. Violle. The author gave a description of the apparatus employed by him in this inquiry. A determination made at Grenoble on June 20 at 3.30 gave the temperature 1,354°, but to get at the true temperature of the sun this number must be corrected for atmospheric absorption and other causes. To eliminate these errors the author has made several ascents of the Alps, but the results are not yet made known.—Some remarks were made on the foregoing paper by M. H. Sainte-Claire Deville; and M. Berthelot communicated a paper *à propos* of these remarks entitled "On high temperatures."—On the application of carbon disulphide mixed with tar and with alkalies for the destruction of *Phylloxera*, by M. C. Monestier.—M. Lecoq de Boisbaudran communicated a note on the use of carbon disulphide for the same purpose.—On a point in the theory of functions, by M. Halphen.—Geometrical integration of the equation $L(xdy - ydx) - Mdy + Ndx = 0$, in which L, M, and N designate linear functions of x and y, by M. Fouret.—New method for determining the index of refraction of liquids, by MM. Terquem and Trannin. The authors gave a description of their apparatus and some of the results obtained by it.—On electro-static phenomena in voltaic batteries, by M. A. Angot.—On the evaporation of liquids at temperatures above their boiling points, by M. de Gernez.—On new apparatus called *accelero-meters*, for the study of the phenomena of the combustion of gunpowders, by MM. Deprez and H. Sebert.—Note on an intestinal calculus of the sturgeon, by MM. Delachanal and Mermet.—Results of the employment of phenol in burials, by M. Prat.—On the publication of the observations of meteors made by M. Coulvier-Gravier, a letter from M. Schiaparelli.—On the structure of the caudal appendage of certain ascidian larvæ, by M. J. Giard.—On the presence of lead in the brain, by M. Daremberg. This was found after cases of lead-poisoning.—M. Chatin was elected during the meeting to supply the vacancy in the botanical section caused by the death of M. C. Gay.

CONTENTS

PAGE
THE COMET. By J. NORMAN LOCKYER, F.R.S. 179
THE CHANNEL TUNNEL 181
OWENS COLLEGE "ESSAYS AND ADDRESSES" 182
OUR BOOK SHELF 184
LETTERS TO THE EDITOR:—
  Sir John Herschel's Letter.—Capt. J. HERSCHEL, R.E., F.R.S. . 184
  Coggia's Comet.—A. C. RANYARD, F.R.A.S. 184
  Photographic Irradiation.—JOHN AITKEN 185
  Lakes with two Outfalls—A Caution.—G. R. JEBB 185
FERDINAND STOLICZKA, PH.D. 185
OBSERVATORIES IN THE UNITED STATES (*With Illustrations*) . . . 186
A MONUMENT TO JEREMIAH HORROCKS 190
FRENCH PREPARATIONS FOR THE TRANSIT OF VENUS 190
ON VAPORISING METALS BY ELECTRICITY. By G. H. HOPKINS . . 190
THE HERPETOLOGY OF NEW GUINEA 191
COGGIA'S COMET. By J. R. HIND, F.R.S. 191
DE CANDOLLE'S PROPOSED "PHYSIOLOGICAL GROUPS" OF PLANTS . 191
NOTES 193
SCIENTIFIC SERIALS 196
SOCIETIES AND ACADEMIES 197

THURSDAY, JULY 16, 1874

SCIENCE IN THE SHOWYARD

It is difficult to over-estimate the benefits which practical agriculture has derived from the great country meetings of our Agricultural Societies. Shifting from year to year to different parts of England these annual exhibitions have brought the general progress of agriculture to bear in a direct manner upon local practice, and made the country farmer acquainted with the improvements that have originated in distant centres of activity; while at the same time the peculiar excellences of the district visited are prominently brought to light, and give their own distinctive character and teaching to the exhibition. The beneficial influence of such Agricultural Shows is much increased when, as in the case of the show now being held at Bedford, they are conducted by a first-class Society. Not only are the exhibitions in this case of greater number, and superior quality, but the character of the judging is superior also, and science is really brought to bear in awarding the prizes in the various classes. To refer to the present show of the Royal Agricultural Society at Bedford, the official lists tell us of the vast number of agricultural implements entered for competition, the class of drills alone including 135 entries. Every one of these implements, before this article is in type, will have been carefully tested by actual work in the field; the quantity of power required to produce a certain amount of work will have been ascertained by a dynamometer contrived expressly for the purpose; the construction of each implement will have been thoroughly criticised; and finally, its merits in each department of its work will have been expressed by an elaborate system of marking. The reports of these trials will in due course appear in the Society's Journal, and the farmer will obtain a valuable mass of information on the subject of implements such as no private individual could have given him. Anyone who desires to see how thoroughly the work of judging is done, and what wonderful skill is now brought to bear on the construction of agricultural machines, should read the two reports on Portable Steam-engines and on Ploughs and Harrows in the last volume of the Royal Agricultural Society's Journal. There can be no question of the immense benefit resulting to practical agriculture from such exhibitions, and from the publication of such reports.

Another chief item in Agricultural Shows, and perhaps the most attractive, is the live stock. The non-agricultural public has seldom any notion of the points aimed at by an intelligent breeder of stock, and those who have never attended one of the country meetings of our great Agricultural Societies may very likely expect to see a mere collection of fat beasts. Our agricultural readers well know that this is far from being the case. Bulk is by no means the object which the breeder has in view; his aim is the production of an animal perfect both in form and quality, and fitted in the highest degree for the various purposes which it is intended to serve. The same principle is also steadily kept in view by the judges, who are instructed by the Society to form their decisions entirely on the animal's character for breeding purposes, and not on its present fitness for the butcher. We need hardly say that our Agricultural Shows have had a large share in that wonderful improvement of our various breeds of stock which has taken place to such a marked extent in recent years.

The subject of the varieties and breeds of cattle is full of interest; indeed we hardly know a more instructive field for the naturalist's study than that presented by the showyards of our Agricultural Societies. Here he will meet with abundant and striking instances of what may be effected by artificial selection persistently carried on with a definite purpose in view; and here also he will meet with equal evidence of the great influence of climate and other ill-understood conditions, which put a limit to the possible work of the breeder, and confine certain varieties to certain districts. That so small a country as Britain should have so many distinct breeds of sheep and cattle localised in different parts of the island is certainly remarkable, and the subject becomes more interesting when we find that in many cases these local breeds cannot be maintained true to their character if transported to other parts of the island. Thus we have in Lincolnshire a breed of sheep remarkable for their long glossy wool. Many attempts have been made to establish flocks of these sheep in other parts of England, but as far as we are aware the peculiar gloss of the wool has always disappeared after a few years.

The effect of external conditions on the character of an animal becomes still more apparent if, after making acquaintance with British sheep and cattle, the naturalist crosses the sea and pays a visit to a continental agricultural show. The British farmer who visited the Vienna Exhibition last year must have stared with wonder at the collection of animals there displayed. He would probably regard with contempt the long-legged, woolly pig, with large and powerful snout, quite unlike the inhabitants of his own styes; but when he learnt that the Transylvanian pig spends its life in the forest, and in winter time has to grub for its food through a foot or more of snow, the British visitor would begin to perceive that the animal is really far better fitted for such a life than his own favourite "Berkshire;" and he would be prepared to hear that English pigs in such districts have proved a failure. Equally remarkable to an Englishman would appear the curious Merino sheep, bred entirely with a view to wool, but worthless considered as mutton, and the fine Hungarian draught oxen, admirably fitted for hard work and hard living, but which no amount of cake would turn into beef at two years old. These would be striking examples of the effect of artificial selection and natural conditions in producing different kinds of excellence from those aimed at in our own country.

In our autumnal shows the naturalist's attention might be directed with equal advantage to the influence of cultivation on the characters of the various seeds and roots exhibited. It is not so very long ago that the first Swede and the first mangold were introduced into this country; the varieties are now endless, and there is probably now quite as much difference between the roots originally imported and their modern representatives as between the greyhound-like swine one sees in old engravings and the present English examples of the race. Artificial selection has, in the case of roots and seeds, taken a wide scope, endeavouring to supply the very various wants of the farmer. Varieties suitable for early and late growth, and for various descriptions of soil and climate, are aimed at, and in many instances produced. The advantage of having a continual supply of *new* varieties appears in some cases to be considerable; thus in the case of the potato disease it seems generally acknowledged that a recently introduced kind resists disease far better than an old sort. Varieties cannot, however, as is well known, be trusted to maintain their character; fresh seed must constantly be employed, and the process of selection must continually be maintained. The trade of the seedsman is thus one of never-ending use and importance. Perhaps one of the most striking recent instances of what may be effected by cultivation with a definite object is afforded by the case of sugar-beet. Beetroot contains somewhere about 8 per cent. of sugar; cultivation, however, and suitable manuring have so increased this percentage that sugar-beet now yields 12-14 per cent. of sugar in the average of seasons, and in favourable seasons 17 per cent. is sometimes reached. We need hardly point out that the practical influence of Agricultural Shows is again most useful in bringing under the farmer's notice both the new varieties raised in this country and the new species introduced from time to time abroad.

The Royal Agricultural Society has lately gone a step beyond the usual limits of the showyard, and has taken advantage of its country meetings to offer prizes for the best-managed farm in the surrounding district. This is undoubtedly a step in the right direction. Hitherto the teaching of the Agricultural Show has been pretty much confined to the subjects of live stock and implements. Certain portions of the farmer's work have been exhaustively illustrated; but farming as a whole has scarcely been dealt with. Might we suggest that the Royal Agricultural Society should go still further in carrying out its admirable motto, "Practice with Science," and endeavour to make its country meetings yet more effective in diffusing true knowledge. Why should not the Society arrange for two or three public lectures in the show-week, to be given by persons eminent in science or in practical agriculture? How much valuable teaching might thus be imparted. The Royal Agricultural Society has already exerted itself in the cause of scientific education for the sons of farmers, and has continued this work in the face of considerable opposition; let it enlarge its good work still further, and aim at teaching the farmers who are annually gathered at its Agricultural Shows.

COLONIAL GEOLOGICAL SURVEYS

II.—VICTORIA

Geological Survey of Victoria—Report of Progress. By R. Brough Smyth. (Melbourne, 1874.)

MR. SMYTH must be a shrewd and clever person. He has one of the most difficult tasks to perform—to persuade or cajole a Colonial Government or Assembly which knows nothing and cares still less about anything scientific, to vote money for a scientific object and to take some interest in having that object carried out. Not many years ago Victoria had a regular Geological Survey, equipped at the colony's expense and directed by Mr. Selwyn, who now so ably conducts the great Survey of Canada. For some reason which we have heard variously described, but which seems to have lain to some extent at least in official jealousies and in differences of opinion as to the degree in which geological research as opposed to mere mineral prospecting should guide the progress of work, the Victorian Survey came to an end and its officers were left to seek employment elsewhere. At the same time the Department of Mines in the colony showed great activity in collecting mining and geological information, the prime mover in this being the secretary, Mr. Brough Smyth. When the Geological Survey ceased to exist he seems to have thrown himself more into a geological line. With no little sagacity and tact he gradually organised a less ambitious scheme for having the country geologically surveyed. He obtained the services of one or two members of the previous Geological Survey, and, with a small grant from the legislature, began to make a geological examination of some of the mining districts, and to prepare maps and sections to show their structure. Under the wing of the Mining Department he evidently could do a good deal without placing a formal vote for a Geological Survey service on the colonial estimates.

How much soever a man may have science at heart, in such a population as that of Victoria he can hardly hope to find much encouragement for science pure and simple. It is needful for him to show some practical utility in his work before he can expect to receive aid, especially of a pecuniary kind. Fortunately in Victoria one great element in the national wealth lies in mining. Anything therefore which tends to increase the value of mines, or to lead to the discovery of fresh mineral fields, appeals at once to the feelings of the colonial legislators.

Mr. Smyth indeed in the present Report grows very bold, going even so far as to assert that the main object of the survey should be scientific discovery, any practical benefit arising from the work being a sort of secondary and accidental circumstance. He takes good care, however, to bring the practical benefits well into the foreground, so that we imagine his superiors are not likely to quarrel with his theory so long as he adheres to his present practice. It would, indeed, be very short-sighted policy to interfere with him. He is unquestionably right in endeavouring to place the knowledge of the mineral structure of the colony on a sound basis of scientific exploration. There may perhaps be no apparent pecuniary return for the outlay at first, but the money expended as he is expending it will assuredly in the end be repaid tenfold. It will save a vast amount of expense in enabling colonists to decide where to begin their mineral ventures and in pointing out where no possible outlay could be profitable. It will stimulate the development of the mineral wealth of the country, and thus add directly and largely to the national prosperity.

We do not notice much of geological novelty in this Report of Progress, though some of the details are interesting, particularly in regard to fresh illustrations of the wonderful volcanic history of some of the goldfields, and to certain of the fossils which have been obtained in recent explorations. A list of all the fossil species hitherto obtained in the colony is inserted in the Report, and forms, so far as we know, the first list of the kind which Victoria has furnished. A considerable proportion of the species is from Upper or Lower Silurian rocks. A few are Devonian and Upper Palæozoic. With regard to Secondary and Tertiary rocks, Mr. Smyth very properly avoids identifying his formations with those of Europe, and contents himself with indicating such indefinite horizons as Lower and Upper Mesozoic. The list of publications on the mines and geological structure of Victoria is already a tolerably long one, and indicates no small amount of activity. It includes Mr. Smyth's work on the "Goldfields of Victoria," which we favourably noticed at the time of its appearance.

Easy-going geologists in this country, who spend their winters comfortably in town, and can at any moment transport themselves by train or steamer to even the farthest parts of the kingdom, have little notion what geologising is in an unexplored region like that of so vast a portion of Australia. Mr. Smyth, for instance, in the most matter-of-fact way refers to one part of geological work in Victoria as "cutting tracks," that is, levelling the trees and scrub in a densely-timbered region so as to make a roadway into the wilds. He truly adds that every mile of such road-cutting is a gain of so much territory to the colony. We find that during three months of last year the survey spent 172*l.* 16*s.* 6*d.* in cutting tracks, each of which was of course a geological section.

But while all this work is going on in his own colony, Mr. Smyth's energies extend over the whole of his continent. At his suggestion, representations have been made to the authorities of the other Australian colonies, to aid in the preparation of a general geological map embracing the whole of Australia and Tasmania. This proposal having been favourably received, considerable progress has been made in the preparation of the map. Mr. Smyth remarks however, that no response has been received from New South Wales, which still remains a blank on his map. No explanation is given of this not very intelligible statement. Certainly there is abundance of information to be had regarding the geological structure of that colony, where, among others, the veteran W. B. Clarke has laboured so long and so well.

As an illustration of the thoroughness with which the Department of Mines endeavours to do its work, it may be mentioned that specimens of rocks or minerals which may be sent up from any part of the country are examined, and if need be analysed, a boon which appears to be taken advantage of to a considerable extent. Appended to Mr. Smyth's Report of Progress is an excellent Report on the Mineral Resources of Ballarat, by R. A. F. Murray, who we believe was one of Mr. Selwyn's staff. The appendix contains also reports on some of the colonial coalfields. In conclusion, it should be added, that this Report is admirably, indeed almost luxuriously, printed and illustrated, presenting a very striking contrast to the blue-books we are accustomed to at home. Mr. Smyth deserves great credit for the way in which he has organised his work, and we trust that a long series of excellent reports may be obtained from him.

ARCH. GEIKIE

THE FISHERIES OF NEW ENGLAND

Report on the Condition of the Sea Fisheries of the South Coast of New England in 1871 *and* 1872. By Spencer F. Baird, Commissioner. (Washington: Government Printing Office, 1873.)

WHILE the question of the supply of fish to the English markets is being year by year more anxiously discussed, and measures taken for the restoration of those fisheries which have been decimated, and for the protection of those whose productiveness is threatened by overfishing, our Transatlantic brethren are engaged in the investigation of a similar question in connection with the produce of their own waters. The wonderful fertility of fish, and the apparently inexhaustible supplies to be found in the waters of all parts of the world, have given rise to the idea that there is no limit to their abundance, and that no appreciable diminution in their numbers can be effected by the most unrestricted fishing. The experience afforded by the example of the salmon fisheries of this country has shown the fallacy of this idea. The most productive rivers have been reduced to absolute unproductiveness, and the most stringent measures have been adopted for encouraging the growth and restricting the destruction of fish. Overfishing, it is found, is not only possible, but has a very speedy effect on the natural supplies; and already the people on the other side of the Atlantic are experiencing the truth of this fact. Notwithstanding the enormous seaboard possessed by the United States, it is found that the supplies of fish are no longer equal to the demand, and the most important fish-producing States have consequently instituted inquiries with the view of adopting remedial measures. Opinions on no subject are more varied and contradictory than on the question of fish supplies. This is inevitable, as comparatively little is known of the habits of fish, and persons are too apt to generalise upon the result of their own limited experience. Finding the testimony of various authorities too conflicting to be of any use, the State of New England appointed Prof. Baird, of the Smithsonian Institution, to make a detailed inquiry into the condition of the fisheries on the coast and lakes of the country generally. The present report is the result of his first year's operations.

Anyone conversant with the fisheries of this country cannot fail to be struck with the similarity that exists between their condition and that of the American fisheries. The river fisheries of England had long been falling into decay, and were almost annihilated, when measures were adopted for their restoration. The river fisheries of America have also fallen off in productiveness, the only astonishing feature being the suddenness of this decay. There are many causes, such as the existence of pollutions, of obstructions, and of navigation, that have militated against the fisheries of this country which have not had equal force in America; but the principal cause of decay has acted more speedily there, and it is apparent that overfishing, and the destruction of spawning fish, have been on both sides of the Atlantic the chief enemy to the continued prosperity of river fisheries. Here salmon, there bass, have been trapped both in their upward and downward progress in the rivers, and no "close season" has been allowed in which they might, unmolested, perform their natural functions of reproduction. In England "fixed engines," *i.e.* devices fixed in the run of the fish, and intercepting almost every individual that would attempt to pass them, have been abolished. In America these instruments are more largely used than ever they were here; and a glance at the diagrams presented by Mr. Baird shows their terribly destructive nature. In some rivers, and on some parts of the coast, they are placed so thickly that no fish can pass them; and, as they are *in situ* all the year round without intermission, it is no wonder that the fisheries are decreasing in value. The total abolition of these engines is suggested as the only real remedy. But the Commissioner is afraid that such a regulation would entail great loss on the owners of such instruments, and would also suddenly interfere with the supply of fish to the public. These traps can fish without human help, while the more legitimate fishermen's nets and gear can only be employed in suitable weather. He recommends that an interval of sixty hours every week should be enforced, during which the use of traps and pounds should be absolutely interdicted; that an annual close time of fifty-six days, viz. from April 20 to June 15, should be established, during which the use of such engines should be prohibited; and that the licensing-system adopted in England should be introduced.

This is certainly a step in the right direction, but we venture to think that a diminution in the number of fixed engines would be advisable, and that such diminution should be partially enforced at once, and be gradually continued till the whole of these instruments are abolished. This need entail very little hardship on individuals, and would certainly not interfere with the regular supply of fish to the markets, while the eventual increase would more than justify the enactment.

In regard to the more purely sea fisheries, the similarity between the British and American fisheries is equally striking, while at the same time the rapidity with which the produce of American waters has fallen off is still more marked. On the English coasts the fisheries are continually fluctuating, but in no part does the diminution in the capture appear to have been so great and so permanent as it is recorded to be in America. The curious extracts from works of two hundred years ago testify to the great natural abundance of fish in the seas adjoining to the American shores; and, to come to more recent years, the printed evidence of living fishermen clearly shows that, for some reason or another, the sea fisheries, like the river fisheries, are much less valuable than they were thirty years ago.

The principal fishes of the coast to which the volume more particularly refers are the "blue fish" (*Pomatomus saltatrix*), also called "horse-mackerel;" the "scup" (*Pagrus* or *Stenotomus argyrops*), "squeteague" (*Cynoscion regalis*), a species of bream; "menhaden" (*Brevoortia menhaden*), a species of herring; sea bass and striped bass (*Roccus* or *Labrax lineatus*); mackerel (*Scomber scombrus*), similar to the common European mackerel; "tautog" or black fish (*Tautoga americana*), of the *Labridæ*, or wrasse family; herring (*Clupea harengus*), and cod, both of the well-known species. Of these, the principal diminution has been found to have occurred among the blue fish, the bass, the scup, and the tautog. The former of these is a very voracious fish, rivalling the shark in its powers of destruction, so much so that to its agency has been ascribed the diminution of other kinds of fish in localities where it is generally caught. But since it has itself greatly diminished, it is hardly possible that the decrease of other fish is attributable in any degree to the depredations of one predaceous kind.

Besides the above there are many other kinds of fish, more or less valuable as food, and sought after also on account of the oil they yield, and for the purposes of utilising them as manure, a complete list of which is given by Prof. Baird. This list is most valuable as condensing and correcting the various imperfect catalogues that have from time to time been made, and as exemplifying the natural richness and fertility of the seas on the seaboard of the Eastern States. As an instance of the extreme difficulty of accounting accurately for the increase and diminution in the capture of fish, we may quote the unexpected appearance of a species of Tunny, a kind of small horse-mackerel (*Orcynus thunnina*), which, though never previously recorded as having been caught on the American coast, was found in great abundance in Menemsha Bight by the Commissioner. The movements of fish are far more difficult to watch and to account for than those of land-animals, and great difficulty is experienced in following them. On some occasions a certain kind of fish has been very abundant in one locality, while a short distance away it has been very scarce; and one fishing-ground has been deserted one year, to be visited by large numbers the next year. One fallacy concerning the movements of the American migratory fish seems quite exploded. To quote Prof. Baird:—

> "It was formerly supposed that certain fish, as the herring, the shad, and the alewives, with others of like habits, prosecuted an extensive migration along the shores of the ocean, covering, sometimes, thousands of miles in the sweep of their travels; and much eloquent writing has been expended by such authors as Pennant and others in defining the starting-point and terminus, as well as the intermediate stages of the voyage. The shad, too, which, as is well known, occupies all the rivers of the Atlantic coast from Florida to the Gulf of St. Lawrence, was thought to begin its course in the West Indies, and in an immense body, which, going northward, sent a detachment to occupy each fresh-water stream as it was reached, the last remnant of the band finally passing up the St. Lawrence, and there closing the course. We now, however, have much reason to think that in the case of the herring, the shad, the alewife, and the salmon, the journey is simply from the mouths of the rivers by the nearest deep gully or trough to the outer sea, and that the appearance of the fish in the mouths of the rivers along the coast at successive intervals, from early spring in the south to near midsummer in the north, is simply due to their taking up their line of march, at successive epochs, from the open sea to the river they had left during a previous season, induced by the stimulus of a definite temperature, which, of course, would be successively attained at later and later dates as the distance northward increased."

It seems pretty well established that, with the American migratory fish, which enter fresh water to spawn, as with the English salmon, the same individuals pass as nearly as possible to the same river, or at least to the same locality, and the same rule applies to their progeny—the young fry appearing to return to the river in which they were hatched.

Of these migratory fish the salmon has been well nigh exterminated, and the shad alone appears to keep up its numbers. Whether or not this is altogether owing to the exertions of the fish culturists, who have hatched artificially many millions of these fish and turned them into the various rivers, it would be rash to say positively; but no doubt this means, and the erection of suitable fish-passes to enable the fish to surmount the weirs, have had a large part in effecting this result.

As regards the practical protection of fisheries, whether in sea or river, the case of the Americans is almost identical with our own; and the remedies to be adopted must be the same in both countries. As regards the scientific side of the question, relative to the habits and distribution of fish, there is much that is new and valuable in the Commissioner's report. Indeed, the greater share of the volume is devoted to such questions, and to the scientific classification, not only of fish proper, but of the various other forms of life found in the waters, and important as either providing food for the useful fishes or as preying upon them.

The various invertebrate animals which form the principal diet of fishes appear to exist in profusion, so that the scarcity of food-fishes cannot be attributed to the want of natural sustenance. Some of these animals which serve as a prey to fish when young, in their turn become aggressors when full grown. An interesting account is given of the destruction caused by various kinds of *Cephalopoda*, which commit great havoc amongst the schools of mackerel and herring. In attacking the mackerel "they would suddenly dart backward among the fish with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck with the sharp beaks;" and yet these same "squids," when young, themselves afford abundant and favourite food to fish.

The subject of sea-bottom is nowhere of such importance as where oysters exist, and Prof. Baird's researches on this point are most valuable. His remarks, which we have not space to quote in full, might be studied with advantage by those who are interested in oyster culture in England and in France.

Nearly 300 carefully executed engravings of the rare and more valuable forms of invertebrata conclude a volume of which but a faint outline has been given.

BALDWIN'S "IRISH FARMING"

Introduction to Irish Farming. By Thomas Baldwin, M.R.I.A., Superintendent of the Agricultural Department of National Education in Ireland, &c. (London: Macmillan & Co., 1874.)

IT is only by the spread of thorough technical education among our farmers that the most will ever be made of the comparatively small area which in these islands can be devoted to agricultural purposes; only by a scientific knowledge of the material with which he deals will the farmer be enabled to improve to the utmost the quantity and quality both of his crops and live stock. By careful selection and suitable feeding vast improvements have within recent years been made in the quality of the latter commodity, and by a scientific study of the various kinds of crops, of soils, and of manures, natural and artificial, rapid progress is being made in forcing "the earth to yield her increase" in greater and greater quantity and of richer and richer quality. No doubt as the reign of science becomes more and more universal, farming, like all other human pursuits, will be followed with more and more of skill founded on accurate scientific knowledge, and will become gradually less a matter of blind rule-of-thumb. In many instances this is the case in Great Britain and in Ireland even now, many of our farmers bringing to bear upon their pursuit a knowledge of the results of the most extensive and exact scientific investigation. It will be long before such an intelligent knowledge becomes universal, we fear; and meantime such manuals as Mr. Baldwin's are of use in spreading among farmers, large and small, who have had no technical training in their occupation, a knowledge, conveyed in popular language, of what can be attained by scientific or skilled farming.

The work comprehends much in comparatively small compass. It treats first of manures, and the necessity of their application to supply the waste in the land caused by cropping. Without going deeply into the chemical properties of soils and manures, it affords plain directions which the unscientific man can clearly understand and appreciate; and considering the general character of the large class which the author essays to enlighten, he has taken the most efficient method for attaining his purpose. His remarks on farmyard manure are just, but he might have expressed his preference for covered yards more strongly, as, besides other advantages, these preserve the manure from rain-water; and, where fodder is in plenty, the liquid is absorbed and utilised in a way which it cannot be to equal advantage when applied by itself. It is well ascertained that dung made in such yards is much richer than in ordinary yards, as from being gradually compressed by the treading of the cattle the ammonia cannot escape, nor any appreciable waste occur. The author's estimate of the quantity of the manure made from one cow in the year at twelve tons is certainly too great if quality as well as quantity is desired.

The second chapter is devoted to the culture and management of green crops and cereals, including potatoes, carrots, turnips, mangold, &c., and the ordinary corn crops. Specific directions are given as to what kinds to sow on particular soils, and how to manage them in the fields and in storing them, each variety being specially referred to in its comparative productiveness and utility. The author's remarks on hay-making are well worthy of perusal. There is no crop so mismanaged as this, especially in Scotland, and considering its extent and value, no censure can be too strong on the negligence and want of skill so generally manifested in securing it.

The third chapter is devoted to live stock, and here the author seems to have studied the various phases of breeding and fattening with a practical eye. Ireland is peculiarly well fitted for rearing stock, and the yearly supply it affords to Great Britain is marvellous. With a moist climate and an alluvial soil, the Irish farmers possess facilities in their fresh swards and luxuriant green crops which we do not possess on this side of the Channel; until at all events we go across the Tweed, and not even there in sufficient breadth and measure, for permanent grass meadows are seldom to be seen. The quality of the various breeds of cattle and sheep is discussed; but it must be remarked that a great complaint on this side of the Channel is made as to the want of quality and growth in much of the supply afforded us; this is no doubt owing principally to the careless selection of breeders, and to too much indiscriminate crossing. The author's remarks on poultry deserve special attention, not that he says anything peculiarly novel, but he treats the subject so plainly and in so much detail, that practical use can be made of his directions on a hitherto too much neglected point in rural economy.

In Chap. IV. examples are given of successful farming, both in large and small holdings, which all interested would do well to peruse. With industry and skill based on scientific knowledge, the productive power of the soil is astonishing. We see this more especially in the arid and sandy ground in Belgium, where two or three acres produce is sufficient for the support of a family. Steam ploughing, no doubt, is an equivalent for spade husbandry in stirring and pulverising the soil, but the personal exertions and superintendence of the cottager in thorough tilling, in careful seeding, successive cropping, manuring, weeding, and harvesting, cannot be excelled or equalled in substantial production. There is, moreover, in Scotland at all events, a degree of comfort and healthy sturdy appearance among that class, now perhaps too limited in number, which bears a striking contrast to the beer-drinking artisan and his wan shrivelled children in towns.

The author concludes with a chapter on cottage-gardening, which may be profitably studied by those of more pretension than the mere cottager. In England the taste for decoration and utility in small gardening is much more manifest than in Scotland, where little else than Scotch kail and weeds are, as a rule, to be seen. Mr. Baldwin has, on the whole, done ample justice to the various subjects he has treated, while the scope of his work is sufficiently comprehensive for the guidance of those who need instruction; and most farmers do, be their rural occupation of small or large compass.

We hope that the spread of works of this class will pave the way for the general circulation among farmers of works of a much more technical and scientific kind, and that ere very long, through the exertions of the Agricultural Societies, both of England and Scotland, Agricultural Schools will be established in convenient centres both in England, Scotland, and Ireland, by means of which the British farmer will be at least on as good a footing as the farmer on the Continent of Europe and in America.

OUR BOOK SHELF

Elementary Dynamics, with numerous Examples. By W. G. Willson, M.A. (Calcutta: Thacker, Spink, and Co.)

Principles of Mechanics. By T. M. Goodeve, M.A. (Longmans' Text-books of Science.)

THE first work on our list does not aim at a novel exposition of principles, though it differs from the ordinary text-books in use amongst junior students. Notes originally put together by the author for the use of pass students of the Calcutta University have, after some considerable trial of their merits, been put together in the present form so as to embrace all the parts of the subjects which are generally treated of in text-books.

Mr. Willson is an ardent admirer of the works by Professors Thomson and Tait ("the magnificent treatise on Natural Philosophy," "the reader who wishes for further information on this subject (and on all such subjects) is recommended to consult," &c.), and his principal aim has been, we expect, to render the views of these distinguished writers more accessible to junior students. Knowing how liable authors are to go to pieces on the kinematic rocks, we have gone as carefully as we could through the text, and it appears to us that the author not only understands his subject, but has manifested ability in presenting his material in a clear form to his readers. Dynamics he subdivides into statics and kinetics. In both these branches he adopts for unit of force the kinetic unit for which the pound avordupois is the unit of mass. We may remark in passing, that this is the only elementary book we know which goes fully and carefully into the subjects of the several units. Under the head of statics, the writer treats of force at a point, of parallel forces, of moments, of centre of gravity, resisting forces, machines, and of work and energy; under the head of kinematics, we have velocity, accelerated velocity, and kinematical principles and methods; under kinetics, we have dynamical laws and principles, the force of gravity (falling bodies, motion on an inclined plane, Attwood's machine, &c.), collision of bodies, and energy. On p. 130, the term *Roman* steelyard is derived from Rumán, an Arabic word for a pomegranate, "and the shape of the counterpoise seems to have given rise to the name." There are a great many examples, many very familiar to us, given at the end of the various chapters. The author apologises for imperfections in type and diagrams, but he need hardly have done so; we have seen worse diagrams in text-books got out nearer home. Some typographical blunders we have detected, but the context will enable a reader to correct them. The work has no index, is of a handy size, and gives one a favourable impression of the sort of training provided for the Calcutta students.

Mr. Goodeve's name is sufficient warrant for the accuracy and thoroughness of any work on mechanics that bears it on its title-page. His style is very lucid, and the accuracy and fulness of his knowledge of his subject enable him to give just sufficient explanation and yet not be too concise. He aims at a different class of students than that we have had to consider in the former part of our notice. These Text-books are designed for the "self-instruction of working men," and the two works by our present author in this series seem to us just fitted for them. In the work before us we are taken over a wide field. In an Introduction of sixty pages we have a miniature treatise, the representation of force, the gravitation measure of force, the laws of motion, and the meaning of the term energy, *inter alia*, are discussed. In the remaining twelve chapters most of the ground gone over in the first-noticed work is gone over rapidly here, and copious application of the principles is furnished by the description of a number of machines, the bare enumeration of the names of which would furnish an ordinary "Bookshelf" notice; in addition we have an account of the equilibrium and pressure of fluids and of gases, of the hydraulic press and hydraulic cranes, a chapter on girder beams and bridges, the strength of tubes and the catenary, all treated without reference (except in one or two places) to the calculus. We have much pleasure in commending this recent addition to the series, with its clear type and numerous and excellent diagrams, to all who take an interest in mechanical applications. There are many excellent exercises scattered throughout the work.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Degeneracy of Man

IN NATURE, vol. x. p. 147, Mr. Edward B. Tylor writes:—

"It would be well worth while if Dr. Peschel, from personal or published sources available to him, would settle once for all the question whether the great Bavarian ethnologist (Martius) continued through life the degenerationist that we in England suppose him to have been."

Now I can assure Mr. Tylor, from having often conversed with Dr. Martius on Brazilian topics, that his degeneration theory belonged to his earlier life, that afterwards he altered his opinions, and that the passage quoted by Mr. Tylor from Martius contained his latest conviction. Soon after the publication of his Ethnography he died at Munich.

OSCAR PESCHEL

DR. MARTIUS found the rude natives of Brazil treating the hunting-ground of each tribe as common to all the tribesmen, but allowing each family to hold as its own freehold the ground which it had built huts on, or brought under tillage. It is not surprising that this ethnologist, comparing such a rudimentary form of the "village community" with its more artificial arrangements in ancient Europe, should have considered the Brazilian tribes to have arrived at an intermediate stage of the development of land-laws, above that of the lowest savages, and on the way to that of more civilised nations. Mr. Edkins, however, in his letter to NATURE, vol. x. p. 163, thinks that Dr. Martius should not have explained the origin of the Brazilian land-law in this obvious way. The suggestion which he offers in its place is, that inasmuch as the Chinese had in old times a highly artificial system of partitioning their village-lands among the heads of families, some of these Chinese are to be supposed to have emigrated to the Brazilian forests and introduced this system, which in course of ages decayed till nothing was left but the simple rule found by Dr. Martius. But is not the word "far-fetched" applicable to this argument? Sooner than allow the rude people of Brazil to have been human beings capable of adopting the simplest social regulation for their own evident benefit, Mr. Edkins sends half-way round the world for imaginary Chinese emigrants, to introduce, not the savage law itself, but a civilised law which, if broken down to its last remnant, might be reduced to the Brazilian level. And, one may go on to ask, where is it likely that the Chinese themselves got their law of village-lands, if it was not developed out of lower stages of the law of property, belonging to lower stages of civilisation? If Mr. Edkins would turn his great knowledge of Chinese matters to investigating the origin of Chinese institutions, I think he would contribute new evidence to the development-theory of culture. Mr. Edkins next brings forward the evidence of numerals in Polynesia as proof of degeneracy in civilisation. The fact that the word *mano* means 10,000 in the Tonga Islands, 4,000 in the Sandwich Islands, and 1,000 in New Zealand, he accounts for on the supposition that the highest number was the original meaning, but that it was lowered with a fall in civilisation. But he will, I think, on further examination be satisfied that the real reason has nothing to do with degeneration, but with the curious Polynesian habit of counting by twos, fours, and even tens. Thus *rau* and *mano*, which in New Zealand mean 100 and 1,000, come to mean in Hawaii so many fours, viz. 400 and 4,000; Mr. Edkins' own example from Ponape shows the same done with tens (see Hale's "Ethnography of Wilkes' Expedition"). Mr. Edkins also remarks that "the Polynesians formerly had a decimal arithmetic; now it has sunk in Australia to quaternary or quinary arithmetic." But the Australians are not of the same race as the Polynesians, nor is there the least reason to suppose that they were ever at a Polynesian level of culture. As the evidence of numerals has been introduced, it may be mentioned that both Australians and Polynesians use numerals derived from counting on the fingers. Thus the Polynesian *lima*, *i.e.* "hand," is the ordinary numeral for five, while the West Australian will say "the hand on either side and half the feet," meaning by this long expression the number 15 (see my "Primitive Culture," chap. 7). I may add that I have been trying for years to get any degenerationist to answer the argument from numerals of this very common class, which can only have arisen by development from the lower stage of counting on the fingers, and which therefore prove savage tribes to be capable of independent intellectual development.

The *Quarterly Review* argument from the recent discoveries of Dr. Schliemann in the ruins he considers to be of Troy, merely shows that low barbarians may build on the ruins of towns previously inhabited by more civilised nations. This often happens, and can hardly be held to prove that the higher civilisation existed in the world before the lower.

As to the observations (vol. x. p. 163) of Mr. Hyde Clarke on affinities which he believes to exist between languages of Brazil and of the Old World, I cannot make any answer, not having seen any comparative vocabularies on which such an opinion could be founded.

EDWARD B. TYLOR

Photographic Irradiation

FOR the purpose of determining whether any sensible amount of the photographic irradiation surrounding the image of a bright object could be traced to an action taking place within the thickness of the collodion film, I some time ago tried an experiment in many respects similar to that detailed by Mr. Aitken in your last number (vol. x. p. 185). A piece of cardboard with four parallel narrow openings, each some 12 in. long, was hung against the glass roof of a photographic studio so as to be projected against the background of a bright sky. One of the slits or openings was covered with a piece of red glass, another was glazed with blue glass, the third was left entirely uncovered, and the fourth was covered by a piece of thin tracing paper. The slits in the cardboard screen were carefully focused, and over-exposed photographs were taken with a camera in which no stops were used. Upon the collodion film and immediately in contact with it was laid a piece of platinum foil quite thick enough to be perfectly opaque. The camera was so placed that the images of the slits fell partly upon the platinum foil and partly upon the collodion film. I have now before me two of the plates, each taken with an exposure of five minutes. The first was coated in the ordinary manner with a single collodion film, but the other was coated three times successively with collodion, so that the film was rendered very thick; but the eating in or encroachment of the photographic images of the slits under the platinum foil is hardly perceptible in either plate; indeed, I feel that I cannot say with certainty whether there is any encroachment of the image proper, though there are very marked brush-like extensions from the ends of the images, as well as a cloudy semicircular field symmetrical with the end of each image, evidently arising from reflections from the back of the plate. At first sight the brush-like semi-opaque extensions might be taken for the ordinary photographic irradiation eating under the platinum foil; but on more closely examining the ends of the images, the hazy opacity is seen to extend farther in some directions than in others, and to be broken up in some cases into five or six little streams or brushes. The decrease in the opacity of the brushes is also less uniform than the decrease in the opacity of the ordinary irradiation border. The brushes extend to a distance of about ·02 in. under the edge of the platinum foil.

I do not at present see my way to devise an experiment which would determine what is the cause of these little brushes, nor have I at present had an opportunity of repeating a similar experiment with the dry-plate process; but the brushes have the appearance to me of having been produced by streams in the delicate film of liquid which must extend under the platinum, streams which probably carry with them little masses of light-altered silver, that are soon deposited or strained out in the spongy tissue of the collodion.

If the spreading action under the platinum foil were caused by light dispersed within the thickness of the collodion, one would expect such action to take place symmetrically around the place where the bright image is cut off instead of being broken up, as I have described, into bundles or brushes. On the other hand, slight differences in the texture of the collodion, or minute inequalities on the edge of the platinum foil, might cause the streams in the liquid film to move more easily at one point than at another.

I should be glad to be informed what was the distance of the opaque bar from the collodion plate in Mr. Aitken's experiments, and whether there is not any photographic trace of defraction bands, owing to the bar not having been in focus; possibly the presence of these may account for the apparent difference in our results. It will be seen that the experiment which I have described points to the same conclusion as that formerly announced by Lord Lindsay and myself, viz. that the inner photographic diffraction edge is chiefly due to the imperfection of the instrument producing the image, chief among which is to be counted the aberration of oblique pencils.

A. COWPER RANYARD

MR. AITKEN'S observations on photographic irradiation in NATURE, vol. x. p. 185, are confirmed by many experiments I have made. I spent a long time in efforts to get rid of irradiation in bromide of silver films, one of the results of which I stated in a former note to NATURE (vol. x. p. 63). There is the most striking difference in the behaviour of films containing iodide of silver only to those containing the bromide alone, the latter, especially when dry, giving much greater irradiation; and the difference is again complicated by the addition of certain substances (notably albumen) to the film in the course of preparation. As my experiments were mainly with dry plates, I will leave out of question the forms which the phenomenon may assume in wet-plate photography, and summarise the results of hundreds of experiments with dry plates iodised, bromo-iodised, and bromised.

With a simply bromised film the amount of irradiation is extreme. The film is very translucent and the irradiation is of two kinds, that caused by reflection from the back of the plate being by far the most extensive, but remediable by the usual expedient of coating the back of the plate with red or black colour, while the form noticed by Mr. Aitken is perhaps partially inherent in bromised films, but to a much greater degree dependent on the nature of the pyroxyline. Two samples of pyroxyline made at different temperatures, and treated in precisely the same manner, differ so much, that while one will, with the coloured backing, give scarcely a perceptible degree of irradiation, the other will develop it to an extent which no backing, nor even tinting the film with the aniline reds, will obviate. The former is generally a compact, lustrous film, scarcely to be distinguished from the glass itself, while the other (both being used without preservative solution) will give a dull and dusty-looking surface, only capable of reflecting at very small angles. If with the latter a strip of blackened wood be laid on the film so as to cut across the lightest portions of the image thrown on it by the lens, the effect of the light will be found to spread behind the strip of wood, sometimes to the extent of a centimetre; but I have never noticed the sharp limitation of this form of irradiation which Mr. Aitken observes, and which probably depends on the wet state of the film. It is clearly, as he supposes, an agitation which is set up in the film, and which depends for its propagation amongst the surrounding molecules upon a kind of chemical transparency in the film holding the bromide of silver. That this is to a great extent true is shown by two experiments: (1) a film which, in its simple state, gives considerable halation, will, when coated with albumen, especially if coagulated with nitrate of silver, give none at all, or very little, though the ocular transparency is rather increased than diminished by the albumen; (2) an emulsion prepared by exposing it to the action of nitrate of silver until it becomes structurally decomposed, and highly charged with bromide of silver, shows absolutely no irradiation under any circumstances even if the glass be not backed, and no kind of preservative used. The film in this case resembles unbaked porcelain in its whiteness, entire want of lustre, and in opacity, and the molecules of bromide of silver are more than usually free from any restraining influence which a preservative might be expected, reasoning from the usual action of the albumen, to exert. In these two cases of extreme translucency and opacity of the film there is almost an equal freedom from the phenomenon in question.

In the old albumen process with translucent films the irradiation is imperceptible, and in the collodio-albumen, where the film of albumen is allowed to remain on the collodion, it is almost so; but in this case, as in all cases where the film is charged only with iodide of silver, there is another element which complicates the action. The bromide of silver is reduced *in situ* while the iodide requires a supply of silver from the developer from which to build up the image, in the one case the deposition being by reduction, in the other by accumulation. This alone would account for a wide difference in respect to irradiation, but will not account for all, as is proven by the diverse results obtained from different bromide films, due to the varying structure of the material which holds the bromide in place.

What Mr. Aitken calls "molecular irradiation" (and which is not by any means the harmless thing he considers it in regard to artistic photography any more than to scientific) is unquestionably the great enemy of all photographic precision. It seems, however, to be complicated with what I have been obliged to call structural irradiation, alluded to above, and depending, as I have said, on the mechanical rather than the chemical condition of the pyroxyline of which the bulk of the film consists. The subject yet demands much investigation, of a purely empirical character, in order to determine the quality of vehicle for carrying the sensitive salts, neither chemical analysis nor chemical analogy affording any indication of the true cause of the difference between the two qualities of pyroxylene I have noted, nor do they, so far as I am aware, account for the difference between the action of collodion and albumen.

W. J. STILLMAN

Altenburgh Gardens,
Clapham Common, S.W., July 13

OBSERVATORIES IN THE UNITED STATES[*]

II.

LIEUT. M. F. MAURY was placed in charge of the new U.S. Naval Observatory, and entered on his duties with zealous purposes. He proposed in 1846 the immense astronomical work of a more extensive and precise cataloguing of the stars than Bessel's "Zone Observations" or Struve's "Dorpat Catalogue." Valuable results of the scheme, so far as it could be entered on, by the observations of Profs. Coffin, Walker, Yarnall, Hubbard, Keith, Major, and Ferguson, and Lieutenants Almy, Maynard, Muse, and others, have been lately reduced and published.

Two events marked this early part of the history with still more importance. Walker, in 1846, proved that the new planet Neptune, just then discovered by Leverrier, had been catalogued as a star by Lalande in his "Histoire celeste" in 1793; and Walker, with Lieutenants Almy and Gilliss, was the very first to use, in 1846, the new discovery of the telegraph to determine differences of longitude. The identification of Neptune with Lalande's star gave astronomers, in determining the new planet's orbit, the use of observations made fifty-two years before. It gave the *American Nautical Almanac* two years earlier ephemerides for the mariner. It brought the observatory into prominence. The superintendency of Maury extended from 1845 to April 26, 1861, when he suddenly left the city to join the cause of the South.

In 1861 Lieut. J. M. Gilliss was at length placed in charge. He re-established and vigorously pressed forward astronomical work as well as the duties of the "Hydrographical Office," a title which had been added to that of the Naval Observatory. After his very sudden death, his successor, Rear-Admiral C. H. Davis, carried forward the astronomical work with that eminent success which had been guaranteed by his previous astronomical tastes and occupancy on the Coast Survey and as superintendent of the *Nautical Almanac*. Rear-Admiral B. F. Sands, succeeding him in the year 1867, has most efficiently improved the opportunities of a longer superintendency to inaugurate and carry forward some of the most important astronomical operations of the day. The phenomena of the total eclipses of 1869 in the United States and of 1870 in the Mediterranean countries were closely observed.

Beyond the regular and severely exacting astronomical routine of observations, two centres of interest have been recently occupying the utmost activities of the institution; the reception, mounting, and use of the new great equatorial, and preparations for the transit of Venus.

The great equatorial has but one near approach to itself in the diameter of its object-glass—that of the private establishment of Mr. R. S. Newall, at Gateshead-on-Tyne, whose telescope has an object-glass of 25 in. in diameter. The Naval Observatory glass has 26 in. clear aperture. It is not easy to realise what this power is, and what it promises. The reader must imagine himself within a dome, itself 41 ft. in diameter and 40 ft. in height, looking through a tube made of three sections of steel stretching away for 32 ft.; the whole telescope and its metallic base weighing about 6 tons.

In the dome, on a pier of mason-work, supported by a pedestal, which is one block weighing 7½ tons, stands the fine equatorial made by Merz and Mahler, Munich, at a cost of 6,000 dols., its object-glass being valued at more than half that sum. The work of this instrument under, successively, Profs. Ferguson, Walker, Hubbard, and Hall, has been chiefly upon the smaller planets, the asteroids, and comets. Mr. James Ferguson was the first American to discover an asteroid, Euphrosyne, in 1854, the thirty-first on a list which has been recently enlarged beyond even a hundred by Peters of Clinton and Watson of Ann

[*] Continued from p 185.

Arbor. The object-glass of the equatorial has an aperture of 9·62 in. and a focal length of 14 ft. 4·5 in. Its powers of positive eye-pieces for use with its filar micrometer vary from 90 to 899.

Descending from the dome, and passing the superintendent's office, in which are a most excellent mean-time clock, with others, in the electric circuit with the clocks at the departments, ticking each, beat for beat, the visitor finds himself in the library, now embracing nearly 6,000 volumes. These are mostly works of the highest standard value, astronomical and meteorological observations and discussions, some being as old as the year 1482, others representing the full work of the European observatories and learned Societies to the present date.

From the library we pass into the transit-circle room, built in 1869, to admire the beautiful instrument, with its collimators and its chronograph. The focal length of the object-glass is 12 ft. 1 in.; its clear aperture 8·52 in.; and the power of its eye-pieces 135 to 396. The diameter of its circles at the outer edge is 45·30 in., and at the graduation 43·40 in., both circles being divided to every two minutes. The power of the reading microscopes is 45·3 diameters. Its collimators have a focal length of 2 ft. 11 in. This instrument, under Profs. Newcomb, Harkness, and Eastman, and their assistants, has had for its chief work the more accurate determination of the stars whose places are computed in the *Nautical Almanac*, and of those needed by the Coast Survey. The chronograph, made by Alvan Clark, is of the form known as the Hipp chronograph, with modifications by Prof. Harkness.

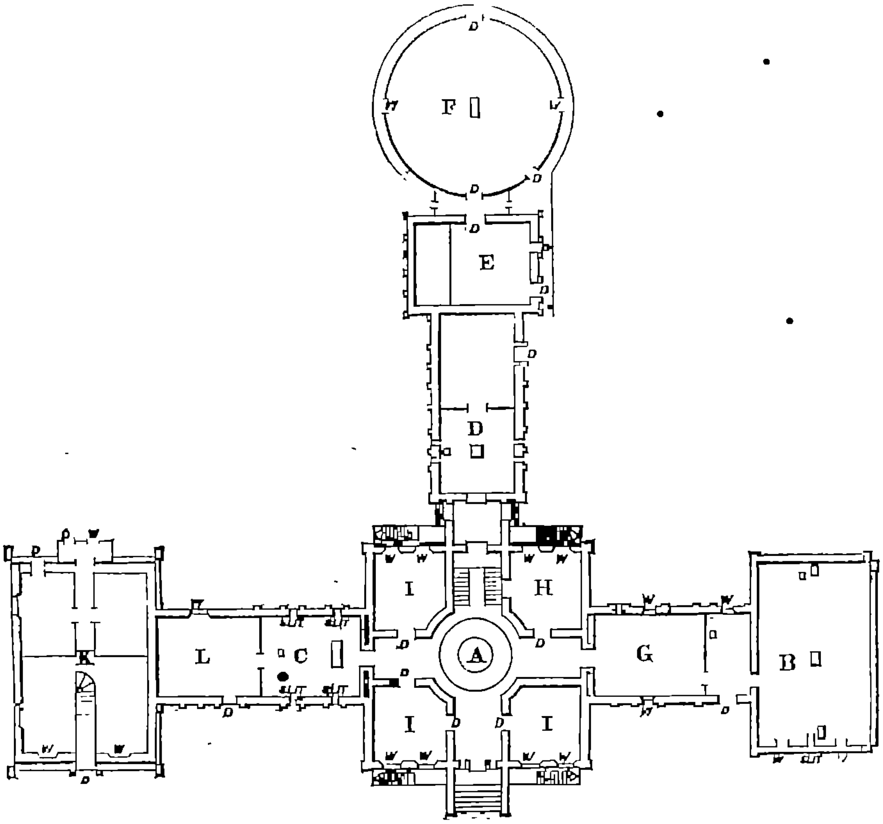


FIG. 6.—The United States Naval Observatory—Ground Plan. A, Pier of Equatorial B, Transit Circle. C, Mural Circle and Transit. D, Prime Vertical. E, Computer's Room for Great Equatorial F, Great Equatorial. G, Library. H, Superintendent's Office. I, I, I, Offices. K, Superintendent's Dwelling. L, Chronometer-Room D, Door. W, Window.

Passing to the eastern wing there are seen, side by side, the mural circle and the smaller transit instrument, with their clock and chronograph. The mural circle has an object-glass of 4·10 in., and a focal length of 5 ft. 3·8 in., the highest power of the eye-pieces being 240. The diameter of the circle at its outer edge, where the graduation is placed, is 60·35 in. It is divided to every five minutes; the power of its reading microscope is 17·1 diameters. The transit has a focal length of 7 ft. 0·4 in., and its object-glass an aperture of 5·33 in.

The chronometer-room shows another and a distinct but important office of the observatory. The relation of all its work to the interests of practical navigation is sufficiently clear. More than 200 time-keepers have been at one time under care in this room. As many as eighty in 1867 were condemned and withdrawn from use. It is as gratifying as it is creditable to American skill to find that the chronometers of Messrs. Negus and Co., of New York, equal, if they do not excel, any of foreign workmanship.

From this room of the observatory the exact time is furnished daily at 12 M. to the Western Union Telegraph Office in Washington for dispatch throughout the United States. The naval officer, standing by the standard mean clock, and having the astronomical correction of that clock also before him, at three minutes before 12 M. calls the telegraph operator at his office, and, at the instant of noon, taps the electric key, giving the time to the company's office. He also drops the dome ball. The chronometer-room is under the very efficient direction of Commander A. W. Johnson, U.S.N.

The seventeen annual volumes of astronomical and meteorological observations now published best set forth in themselves the work of the observatory. The latest of these volumes vie in extent and in value with the publications of Greenwich and Paris. The star catalogue, issued as Appendix No. 1 to the volume for 1871, embraces more than 100,000 observations, giving the places of 10,000 stars. It is the twenty years' work of Prof. M. Yarnall, embracing the reduction of his own observations and those of others from the year 1845 to 1871. The astronomer knows how to appreciate such a work.

Congress, in whose hands is the destiny of the institution, has promptly appreciated its claims, and does not withhold the liberal appropriations asked for it as due to astronomy and to this branch of naval efficiency.

West Point Observatory.—This observatory was erected in 1839 for astronomical purposes and the accommodation of the library of the Academy and its philosophical apparatus. The institution of an observatory is to be credited to Prof. W. H. C. Bartlett, LL.D., so well known for more than thirty years as its director. In 1840 Prof. Bartlett visited Europe for the United States Government, inspected and reported upon its chief observatories, submitting also a plan for an observatory at Washington, and purchasing for West Point whilst abroad its three large instruments, the equatorial, the transit, and the mural circle.

The transit instrument in the east tower was made yb Ertel and Son, and its object-glass by Merz and Mahler, at Munich, the whole cost being about 1,130 dols. It was mounted in 1843, the memorable year for observatories in the United States. Its object-glass has a clear aperture of 4·62 in., and a focal length of 76·75 in. It is provided with four eye-pieces and one dark glass, and has an illuminating apparatus, giving either a bright field with dark lines, or a dark field with bright lines, which can be modified at will by means of a coloured wedge. The reticule has seven vertical and two horizontal lines. An extra vertical wire is driven in a horizontal direction by means of a micrometer screw, each division of which corresponds to $0''\cdot334$. It has a striding level, each small division being $1''\cdot23 = 0\cdot082^s$. The steel pivots have not sensibly changed their equality of dimensions since the instrument was mounted.

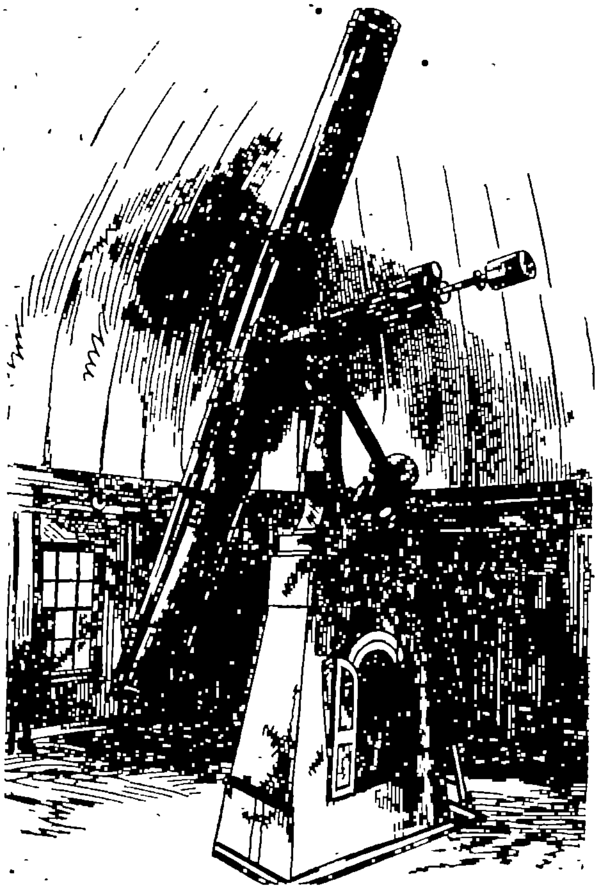


FIG 7.—The Great Equatorial—United States Naval Observatory.

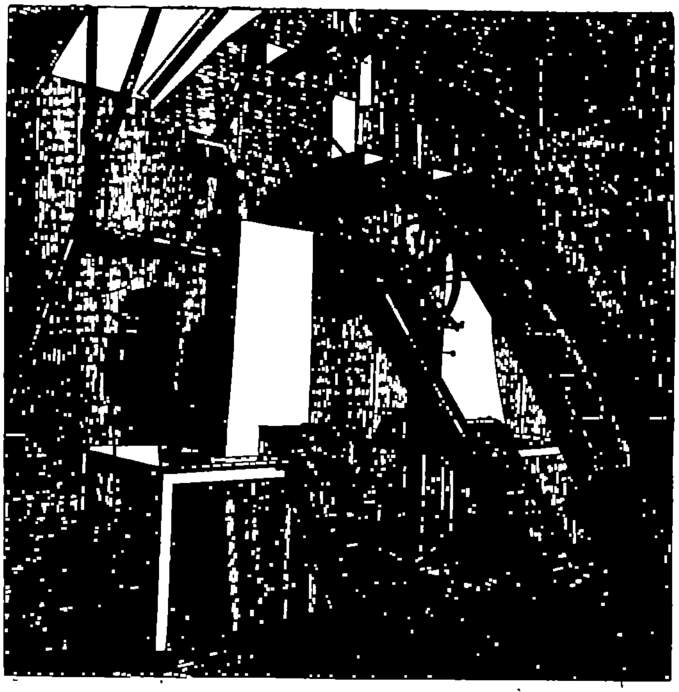


FIG. 8.—Transit Circle—United States Naval Observatory.

The west tower has the mural circle, by Troughton and Simms, of London. This was cast in one entire piece of brass. Its diameter is 5 ft., and its graduations are on two bands, one of gold, the other of palladium. The telescope has a clear aperture of 4 in., with a focal length of 60 in.

The central main tower has a revolving dome of 27 ft. in diameter, which rests on six 24-pound cannon-balls, turning between cast-iron annular grooves. The equatorial, made by Mr. Henry Fitz, of New York, has a focal length of 14 ft., and a clear aperture of 9⅝ in. It has thirteen eye-pieces. The hour circle reads to two seconds of time, and the declination circle to twenty seconds of an arc, each circle being 20 in. in diameter. This instrument cost 5,000 dols.

The sidereal clock, by Hardy, has a Bond break-circuit attachment, and is connected with the several instruments by wires and break-circuit keys. Besides these there are valuable portable instruments in the observatory, which lends them from time to time to topographical and surveying parties in the west and north-west, or to stations of the Engineer Corps, like the one at Willett's Point, New York. Several valuable additions, including a Bond chronograph, the odolites, and sextants, have been made within the last two years.

The purposes of the observatory of the Academy are most effectively secured by confining its workings to the end of educating the cadets in the knowledge and practical use of the instruments. During the spring months they are taken in parties of two, three, or four to receive such instruction, and are required themselves to make observations, with each instrument, and reduce them. During the summer encampment a month is devoted to further instruction in connection with a field observatory at Fort Clinton, where they use a field transit, zenith telescope, and other instruments. Each makes his own records, and works out his results for the ordinary problems of time, latitude, longitude. Würdeman of Washington is constructing for this field observatory a new transit and zenith telescope.

Although the chief design of the observatory has been from the first to secure such proficiency in the cadets as would prove of most value to them in the field work to which so many army officers are called, and although neither the professors nor their assistants, who are daily instructors in several other branches, can find time available for lengthened series of observations, still at different times valuable observations have been secured in the midst of pressing duties. Among these are those of Prof. Bartlett on the great comet of 1843, published in the Transactions of the American Philosophical Society, and recent observations under Prof. Michie and his assistants, Lieut. Bass and others, for determining the longitude of the observatory.

Annapolis Observatory.—We cannot complete this sketch of the United States Government observatories without a just, though necessarily very brief, notice of the observatory used in the instruction of midshipmen at Annapolis.

The Department of Astronomy was created in 1853, and until 1865 was in charge successively of Profs. Chauvenet and Coffin. Since that time a graduate of the Academy has from time to time been in charge. The course in astronomy is of necessity limited, most of the midshipman's time in this department being required for the study of practical navigation. We learn from the report of Lieutenant-Commander R. L. Phythian to Admiral Porter in 1869 the following facts:—"The instruments used in this department are the chronometer, the sextant, the artificial horizon, the azimuth compass, the surveyor's chain and compass, the theodolite, and the plane-table. The observatory is supplied with a sidereal clock, an equatorially-mounted telescope, and a superior meridian clock. These instruments are used in instruction only to show the midshipmen the principles of them. There is not sufficient time for them to acquire a practical knowledge of their use by observing with them."

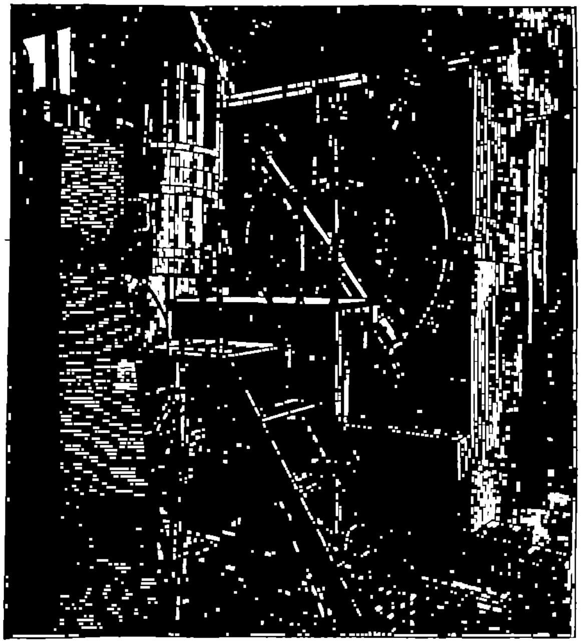


FIG. 9.—Mural Circle and Smaller Transit Instrument—United States Naval Observatory.

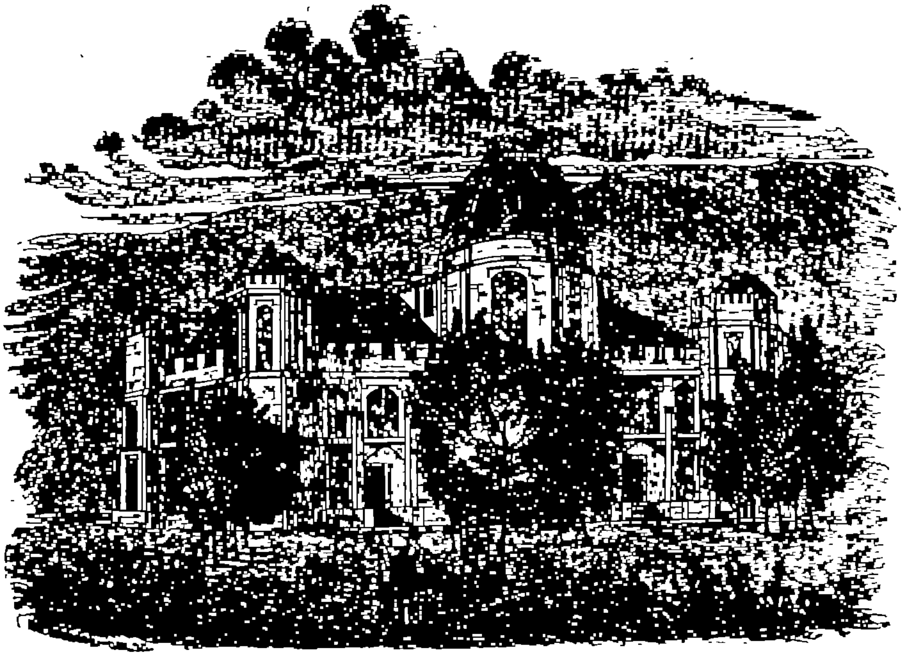


FIG. 10—West Point Observatory—North Front.

Altogether the United States has reason to be proud of her observatories, and of the work already done by her astronomers.

THE RELATIONS BETWEEN HUMAN MORTALITY AND THE SEASONS OF THE YEAR

AT the anniversary meeting of the Scottish Meteorological Society, a very valuable paper was read by Dr. Arthur Mitchell, and the Secretary, Mr. Alex. Buchan, giving an account of their investigations on the subject of the influence of the seasons on human mortality at different ages as caused by different diseases. The authors have calculated the weekly average death-rate of London for the past thirty years for thirty-one diseases, together with the averages of temperature, moisture, rain, &c. Considering the weather experienced in the course of the year as made up of several distinct climates differing from each other according to the prevailing temperature and moisture and their relations to each other, the influence of these climates, characterised respectively by cold, cold and dryness, dryness and heat, heat, heat and moisture, and cold and moisture, on the mortality was pointed out. The weekly mortality from all causes and at all ages shows a large excess above the average from the middle of November to the middle of April, from which it falls to the minimum in the end of May; it then slowly rises, and on the third week of July shoots suddenly up almost to the maximum of the year, at which it remains till the second week of August, and thence falls as rapidly as it rose to a secondary minimum in October. Regarding the summer excess in the death-rate, which is so abrupt in its rise and fall, it was shown that it is wholly due to one section of the population, viz. infants under five years of age, none of the curves for the other ages showing an excess in the death-rate from all causes during the summer months; and it was further shown that the summer excess is due not only to the deaths at one age, but to the deaths from one class of diseases, viz. bowel complaints. The importance of weekly averages in discussing these sudden fluctuations of the death-rate to the changes of the weather was pointedly referred to. Deducting the deaths from bowel complaints from the deaths from all causes, the curve assumes a simple form, viz. an excess in the cold months and a deficiency in the warm months. In other words, the curve of mortality is dictated by the large number of deaths from diseases of the respiratory organs. The curve of mortality in London has thus an inverse relation to the temperature, rising as the temperature falls, and falling as the temperature rises. On the other hand, in Victoria, Australia, the curves of mortality and temperature are directly related to each other—mortality and temperature rising and falling together. The character of the curve of mortality in Victoria is impressed on it by the deaths of persons below the age of five; and among such young persons the special diseases which determine this influence are diarrhœa and dysentery. This peculiarity arises from its higher mean temperature, 57°·6, as compared with that of London, 50°·0. In London also during the hottest months of the year the curves of mortality and temperature rise and fall together, whereas in Victoria the curves are throughout the whole year directly related; for though doubtless the deaths from diseases of the respiratory organs fall as the temperature rises, and rise as the temperature falls, yet the number of deaths from these diseases is, owing to the comparatively high winter temperature, never sufficiently large to influence the curve of the whole death-rate. The curves of mortality for bronchitis and pneumonia at different ages prove that the fluctuation is much less for pneumonia than for bronchitis, and that the excess in both cases of infant mortality is great, but not nearly so great as the infant mortality for diarrhœa. The curves show that the maximum mortality from the different diseases group around certain specific conditions of temperature and moisture combined, the general result of which, as regards the principal diseases, may be thus roughly stated :—

Character of Weather	Maximum Mortality
Cold	Bronchitis, pneumonia, asthma, &c.
Cold and dry	Brain-disease, convulsions, whooping-cough
Warm and dry	Suicides, small-pox
Warm and moist	Diarrhœa, dysentery, cholera
Cold and moist	Rheumatism, heart-disease, diphtheria, scarlatina, measles, croup

The deaths from cancer and liver disease show no distinct relation to weather. The period of the year least marked by the occurrence of maximum mortality from any disease is the warm dry weather which prevails from the middle of May to the end of June. At this season the only maximum is a well-pronounced secondary maximum for measles; and the maxima for suicides and small-pox, which are, however, extended from the middle of April into these months. Convulsions, teething, and atrophy and debility have a secondary maximum in the warm moist weather of July and August. In the United States, where the heat is greater in summer, the secondary maximum for convulsions is more distinctly marked than that of London; and in Victoria the summer maximum is the only one that appears. The contrast offered by certain curves to each other in all points is very striking. Thus the curve for whooping-cough begins to rise above its average in the middle of December, attains its maximum in March and April, and falls to the minimum in September and October, whilst the curve for scarlatina is exactly the reverse of all this, having its minimum in spring and its maximum in autumn. It was inferred from the general teaching of the curves, that if a curve representing the progress of the death-rate from a particular disease were given for a place whose climate was known, though it might be impossible to name the exact disease, it would be possible to say with a considerable degree of certainty whether, for instance, the nervous system, or the respiratory organs, or the abdominal organs were involved in the disorder which caused the deaths.

CONFERENCE ON THE REGISTRATION OF PERIODICAL NATURAL PHENOMENA

THE Council of the Meteorological Society recently resolved to organise a system of Observations of Natural Phenomena, connected with the return of the seasons, as well as of such branches of physical inquiry as tend to establish a connection between meteorological agencies and the development of vegetable life.

As a preliminary to carrying out this intention they invited the various Societies before which such subjects most naturally come to nominate delegates to join a committee by whom the whole question as bearing upon agriculture, horticulture, &c., should be considered, and to whom also any written communications should be submitted.

The first meeting of this joint committee was held at the Office of the Meteorological Society, 30, Great George Street, on Thursday, July 2, when delegates were present and promises of co-operation read from the Royal Horticultural, Royal Agricultural, Royal Botanical, and other Societies. After the subject had been fully discussed the Rev. T. A. Preston, of Marlborough College, was requested to prepare a list of plants to be observed, and also to draw up a report on the same. Other gentlemen were requested to prepare lists of insects, birds, and animals.

THE SPECTRUM OF THE AURORA BOREALIS *

THE author's object in this paper is to make a small contribution towards the solution of the question, how the composition of the spectrum may be most correctly explained?

---

* By the late Prof. A. J. Angström.

It may be assumed that the spectrum of the aurora is composed of *two* different spectra, which, even although appearing sometimes simultaneously, have in all probability different origins.

The one spectrum consists of the homogeneous yellow light which is so characteristic of the aurora, and which is found even in its weakest manifestations. The other spectrum consists of extremely feeble bands of light, which only in the stronger auroræ attain such an intensity as enables one to fix their position, though only approximatively.

As to the yellow lines in the aurora or the one-coloured spectrum, we are as little able now as when it was first observed to point out a corresponding line in any known spectrum. True Piazzi Smyth (*Comptes Rendus*, lxxiv. 597) has asserted that it corresponds to one of the bands in the spectrum of hydrocarbons; but a more exact observation shows that the line falls into a group of shaded bands which belong to the spectrum, but almost midway between the second and third Herr Vogel has observed that this line corresponds to a band in the spectrum of rarefied air (Pogg. Ann. cxlvi, 582). This is quite right, but in Angström's opinion is found on a pure misconception. The spectrum of rarefied air has in the green-yellow part seven bands of nearly equal strength; and that the auroral line corresponds with the margin of one of these bands, which is not even the strongest, cannot be anything else than merely accidental.

Observations on the spectrum have not hitherto agreed with each other; partly, perhaps, because of the weak light of the object, but partly also, it may be, on account of the variability of the aurora. The red does not always appear, and when it does is often so weak that it cannot be observed in the spectroscope. If now it be assumed that the aurora has its final cause in electrical discharges in the upper strata of the atmosphere, and that these discharges, whether disruptional or continuous, take place sometimes on the outer boundary of the atmosphere, and sometimes near to the surface of the earth, this variability will easily show in the appearance of the spectrum what the observations appear to confirm.

If we consider the conditions under which the electric light appears on the boundary of the atmosphere, moisture in that region must be set down as nil, and consequently the oxygen and hydrogen there must alone act as conductors of electricity. Angstrom has tried to reproduce these conditions on a small scale. Into a flask, the bottom of which is covered with a layer of phosphate, the platinum wires are introduced and the air is pumped out to the extent of several millimetres. If the inductive current of a Ruhmkorff coil be sent through the flask, the whole flask will be filled, as it were, with that violet light which otherwise only proceeds from the negative pole, and from both electrodes a spectrum is obtained consisting chiefly of shaded violet bands.

If this spectrum be compared with that of the aurora, Angström thinks that the agreement between the former and some of the best established bands of the latter is satisfactory.

Lines		Wave-lengths		
Of the aurora spectrum	According to Barker	431	470·5	
	" " Vogel	—	469·4	523·3
	" " Angstrom	—	472	521
	" " Lemstrom	426·2	469·4	523·5
	Mean	428·6	470·3	522·6
Of the spectrum of the violet light		427·2	470·7	522·7

In the neighbourhood of the line 469·4 Herr Vogel has moreover observed two weak light bands, 466·3 and 462·9. The spectrum of the violet light has also two corresponding shaded bands, 465·4 and 460·1.

Should the aurora be flamy and shoot out like rays, there is good reason for assuming a disruptive discharge of electricity, and then there ought to appear the strongest line in the line-spectrum of the air, the green, whose wavelength is 500·3. Precisely this has been actually observed by Vogel, and has moreover been seen by Angstrom and others.

Finally, should the aurora be observed as it appears at a less height in the atmosphere, then are recognised both the hydrogen lines and also the strongest of the bands of the dark-banded air-spectrum, as *e.g.* 497·3. There are found also again nearly all the lines and light bands of the weak aurora spectrum, whose position has with any certainty been observed.

There still remains the line in the red field, the wavelength of which, according to Vogel, may be valued at 630. Angstrom has chanced to see it only a single time, while on various occasions, when the aurora has shown red lights, he has found it impossible to distinguish any lines whatever in this part of the spectrum. The cause of this may be that while the red bands in the spectrum of the negative pole are broad and very feeble in light, the corresponding light in the aurora may be imperceptible in the spectroscope on account of the dispersion of the prism, although it is strong enough to give to the aurora a reddish appearance. Angstrom does not venture to decide whether the red line observed by Vogel coincides with the strongest of these bands, but so much is at least certain, that it may coincide with more than one of the bands to the red field of Plucker's air-spectrum.

In general it may be thus assumed that the feeble bands in the aurora spectrum belong to the spectrum of the negative pole, and that the appearance of this spectrum may be changed more or less by additions from the banded air-spectrum or the line-spectrum of the air.

But by this is not yet explained the one-coloured spectrum or the origin of the yellow line. The only explanation of the origin of this line which in Angström's opinion is in any way probable, is that it owes its origin to *fluorescence* or phosphorescence. Since fluorescence is produced by the ultra-violet rays, *an electric discharge may easily be imagined, which, though in itself of feeble light, may be rich in ultra-violet light, and therefore in a condition to cause a sufficiently strong fluorescence.* It is also known that oxygen is phosphorescent, as also several of its compounds.

There is therefore no need, in order to account for the spectrum of the aurora, to have recourse to the "very great variability of gas spectra according to the varying circumstances of pressure and temperature," a variability which according to Angström's twenty years' observations does not exist. Just as little can Angstrom admit that the way in which a gas may be brought to glow or burn, can alter the nature of the spectrum; since it is an established fact in physics that the state of light and of heat which puts a body into a glowing condition is unconnected in character with that which produces glowing.

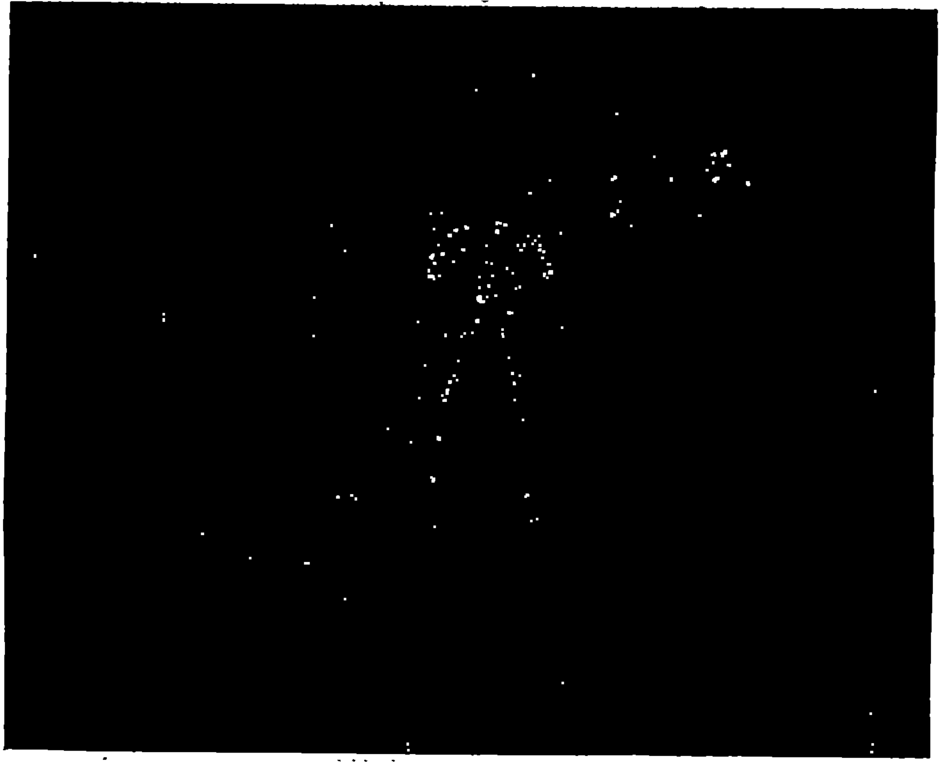
Angstrom does not entirely deny the possibility that a simple body by glowing in a gaseous condition will offer several spectra. Just as one simple body can form a chemical combination with another, and this body by glowing in a gaseous condition, so long as it is not decomposed, gives its own spectrum, so must it also be able to form combinations with itself—thus to form isomeric combinations—it being always supposed that it exists in the gaseous form and can maintain itself in a glowing condition without decomposition. In this way it is indeed possible to conceive an absorption for oxygen which belongs to ozone; but since ozone, as is well known, cannot maintain itself in a glowing condition, it is in vain to look for more than one spectrum of oxygen. There is, however, at least a possibility of obtaining several spectra from sulphur, while again with respect to carbon, which cannot even be exhibited in a gaseous condition, a like assumption in the author's opinion wants the support of experience.

THE COMET

WE have received from Mr. Lockyer, who has been observing the comet with Mr. Newall's 25-inch refractor, the accompanying rough sketch of its general appearance in that instrument. The drawing he states is only intended to show the features in their most general aspect, in order that the striking differences between the present comet and former ones may be apprehended.

His observations, to which we hope to refer at some length, extended over several hours on Sunday and Tuesday nights, and great changes were observed.

One of the new observations made was that a photographic plate exposed for ten minutes gave no results on the comet, while the dimmest of the seven stars in the Great Bear, inferior to the comet in brightness, recorded itself in two minutes' exposure.



Rough Outline Sketch of Head and Envelopes of Coggia's Comet as seen in Mr. Newall's 25-inch Refractor on the night of July 12

It is hoped that the observations, made under first-rate atmospheric conditions, with the magnificent instrument with which Mr. Newall has endowed British Astronomy, will throw light upon cometary structure, and help to clear up many anomalies.

JASPER'S "BIRDS OF NORTH AMERICA"*

A SHORT time ago we gave our readers some account of the important work of the "Birds of North America," lately issued by Prof. Baird with the co-operation of some of the principal naturalists of the United States. It has just come to our knowledge that a rival work has been started with nearly the same title, concerning which it may be useful to such of our readers as turn their studies in an ornithological direction that we should say a few words.

Jasper's "Birds of North America" appears to have been started by an enterprising publisher at Columbus, Ohio, "to meet a common want and gratify a universal taste." It is issued in numbers, the first of which bears date Nov. 1, 1873. It is to contain coloured figures and descriptions of over 600 species, and a popular account of their habits and manners—likewise a general outline of the science of ornithology—all from the pen and pencil of Dr. Theodore Jasper, "who has made the study of ornithology the business of his life."

Now we have no desire at all to interfere with Mr. Jacob H. Studer's undertaking. We quite agree with Mr. Studer's notions that a knowledge of American birds is or should be a "common want," and we are also of opinion that a "universal taste" should be gratified if possible. At the same time we must be allowed to say, after examining what has yet appeared of Mr. Jasper's work, that, in our judgment, those who wish to become well acquainted with American ornithology had better consult Prof. Baird's volumes. Mr. Jasper, it is true, furnishes coloured figures of every species or proposes to do so. But these, prepared by chromolithography or some similar process, are not sufficiently carefully coloured for the discrimination of specific differences—at any rate as regards the smaller birds. And in every other particular Baird's "American Birds" is far superior. Mr. Jasper's work can indeed be hardly placed in the same category, the author being obviously acquainted with little more than the results of his own experience, whilst Prof. Baird and his coadjutors are fully up to the level of modern science.

---

* "The Birds of North America, drawn from life and uniformly reduced to one-quarter their natural size," by Dr. Theodore Jasper. In 4to. parts. Columbus, Ohio, 1873-74.)

NOTES

THE statue of Dr. Priestley will be unveiled at Birmingham on Saturday, Aug. 1 (the centenary of his discovery of oxygen). Prof. Huxley will make the presentation to the town, on behalf of the subscribers, and will deliver an address in the Town Hall.

WE understand that the recently established Stricklandian Curatorship in the Cambridge University Natural History Museum has been offered to and is likely to be accepted by Mr. Osbert Salvin, F.R.S., one of our most distinguished ornithologists.

LORD LILFORD has just returned from a natural history cruise in the Mediterranean, and amongst the most interesting specimens he has brought home with him is a pair of Audouin's Gulls (*Larus audouini*) from the small island of Toro on the coast of Sardinia, which he has deposited in the gardens of the Zoological Society. The rareness of these birds makes them of peculiar interest.

A LARGE collection of giraffes, antelopes, and other African mammals has lately been imported into Hamburg by Mr. C. Hagenbeck, the well-known dealer in animals of that city, from the Atbara district of Upper Nubia. Three of the finest giraffes have been secured by the Zoological Society, and are daily expected to arrive in London.

A REPORT is said to be current at St. Petersburg that the Austrian Polar Expedition, of which nothing has been heard for a considerable time, and respecting the safety of which apprehension is accordingly entertained, is lying off the coast of Novaya Zemlya.

THE Caen Academy of Science and Art proposes as the subject of the Le Sauvage prize, of the value of 4,000 francs, to be awarded in 1876, the question of the Function of Leaves in the Vegetation of Plants. The Academy does not want simply an exposition of the present state of Science on this important question; it requires, besides, from competitors, exact experiments performed by themselves, and new facts tending to throw light upon, invalidate, confirm, or modify doubtful points in the theories at present accepted. The memoirs ought to be sent to the Academy before Jan. 1, 1876.

A FIFTH "sub-edition" of Dana's "Mineralogy" has been issued, with an appendix, by Prof. Brush.

JOSHUA HOOPES, the last survivor of the old school of the botanists of Chester County, Penn., of which Darlington was the chief, and the "Flora Cestrica" the memorial, died on May 11 at the age of 86.

MR. HERBERT SPENCER has published in a separate form, with some additional correspondence and comments, the correspondence which was carried on in NATURE between himself, the "Quarterly Reviewer," Mr. R. B. Hayward, and others.

M. LEVERRIER has presented to the Council of the Observatory a new set of regulations for the better working of the establishment. In drawing out these regulations the illustrious astronomer took advantage of the visit he recently made to Greenwich Observatory.

MAGNETIC instruments are to be erected on a piece of ground situated between the Boulevard Arago and the Observatory Gardens, Paris. This land belongs to the French Government, which has given it up for the purpose mentioned.

M. FAYE has been nominated President of the Bureau des Longitudes. M. Janssen, who was a member of the Section of Geography, has been appointed by the Minister a member of the Section of Astronomy. There will be an election to fill up the place thus vacated. This is the first time that a member has been transferred from one section to another.

DR. GARRIGOU, of Bagnères de Luchon, has established, at his own expense, a laboratory for analysing the mineral waters of the Pyrenees. The laboratory is open to men of science for their own researches.

THE Worshipful Company of Clothworkers has founded a "Professorship of Textile Industries" in connection with the Yorkshire College of Science, with a stipend of 300*l.* a year and two-thirds of the students' fees. The stipulated qualifications for the post have been just announced. The selected candidate will be required to have a practical knowledge of all materials used in the woollen and worsted manufactures, and the selection of materials for special kinds of goods; to be able to give instruction in every department of weaving, including the practical handling of the loom; plain drawing, and analysis of patterns; to apply the laws of colour to the production of coloured designs, and to finish coloured designs on paper, prefiguring the woven fabric; to make all the calculations required in the manufacture of woollen or worsted goods; to explain and illustrate the processes of carding, combing, and spinning; and to give practical illustrations of scouring, fulling, and finishing. The chemistry of dyeing will be taught by the Professor of Chemistry. It will be a condition of appointment (*inter alia*) that the Professor is to give lectures at stated times upon improved modes of manufacture at other of the chief towns connected with the cloth-working industry both in Yorkshire and the west of England.

THE result of the Sandwell Park trial sinking for coal being that a seam 20 ft. 6 in. has been found at a depth of 418 yards, it is proposed to furnish an account of the fossils met with and the general character of the red rocks passed through. Prof. Ramsay and others have promised their assistance for this work.

URIAH A. BOYDON, of Boston, has deposited with the Franklin Institute the sum of 1,000 dols. to be awarded as a premium to "any resident of North America who shall determine by experiment whether all rays of light, and other physical rays, are or are not transmitted with the same velocity." The memoirs, which are to describe in detail the apparatus, mode of experimenting and results, are to be sent in to the secretary of the Institute by Jan. 1, 1875. The Institute is to appoint three judges, and has reserved to it the power to decide whether or not the recommendation of the judges shall be carried out. Should the judges think proper, they may require the experiments described in any of the memoirs to be repeated in their presence.

THE report of the State Board of Health of Massachusetts, 1874, says that a large part of the 450 analyses there given were performed by a lady in the laboratory of the Massachusetts Institute of Technology.

THE Geological Society of France intends to hold its annual session this year at Mons, immediately on the conclusion of the session of the French Association for the Advancement of Science. The meetings commence on August 30, and will last about a week, during which some interesting excursions have been arranged for.

IN the Engineering Department of King's College the following Physical Science Exhibitions will be given in October next. The Treake Entrance Exhibition of 20*l.*, also two Exhibitions of 30*l.* and 21*l.* will be given by competitive examination among the students matriculating in this department at that time, provided a satisfactory degree of proficiency is shown by the candidates. The examination will consist of four papers, two in mathematics, one in elementary mechanics and physics, and one in chemistry, and will take place on Thursday, October 1, and two following days.

THE Provost and Fellows of Worcester College, Oxford, have voted the appropriation of 2 per cent. of their revenues to non-collegiate University uses, and have resolved that this sum for the next five years shall be paid in equal proportions to the Bodleian Library and University Museum.

MR. F. BUTLER, B.A., of Worcester College, who obtained a first class in Natural Science at the recent examination at Oxford, has been appointed Natural Science Master of Reading School, and during the vacation a laboratory will be fitted up at the school under his supervision.

THE large and lucrative industry which has sprung up on the American coasts in the preservation of lobsters in tins, has induced some energetic persons to start a lobster farm near Boston, where an area of about 32 acres has been laid out and protected for the purpose of cultivating the lobster. On the seaward side it is closed by banks, having hatches or sluices so as to admit of the flow and ebb of the tide. Last summer about 40,000 lobsters, of all sizes, were deposited in this ground. The maimed and the halt and the lame and probably the blind are accommodated with quarters where they can recover their lost claws; and a *crèche* for the infantine population is provided, where they can increase without the ordinary dangers attendant on lobsterial infancy. Food, in the shape of refuse fish, &c., is liberally supplied to this interesting community. In the winter the managers evinced the natural deceitfulness of human nature by catching and scalding the lobsters on which so much attention had been lavished, and a fine harvest rewarded them; 15,000 fine lobsters were sold, and the success of the experiment seems complete. Besides lobsters, it is intended that the farm shall be turned to account by being made a nursery for fish of various kinds. As a matter of fact many eels and other fishes were caught in the spring. The venture seems a very successful one; and in view of the enormous drain on the natural lobster grounds of America, it is very necessary that some such steps should be taken, as a supplement to the regulations proposed to prevent overfishing, and fishing in the breeding season.

THE suggestion has been made that kangaroos might be generally cultivated in parks and other enclosures in this country; and it is probable that they would prove quite as useful as deer. A French naturalist, M. Cornély, has recently published some novel information on the subject, which seems to show that the proposal is perfectly feasible in every way. The experience of the various zoological societies in Europe shows that this marsupial will thrive and breed in our climate, damp being the only condition which is fatal to it. It will bear great extremes of heat and cold without injury. M. Cornély says that they are not destructive to trees and shrubs, and that if any individuals contract the habit of barking trees, they can be broken of it by shutting them up for two or three days without food. On being released they are so eager in search of grass that they do not touch the trees. As an ornamental adjunct to an English park, the presence of kangaroos would prove very valuable; their skins are highly prized on account of the quality of the leather, and most probably the principal obstruction to the more general cultivation of the animal is the prejudice that exists against the introduction of novelties.

A SEVERE earthquake is reported to have occurred in Utah at midnight on June 18.

WE learn with great pleasure that during the last three years there has been a very successful class for botany in connection with the Royal Veterinary College. From some notices of excursions made during the present summer which have been sent us, we see the field-class is one of the largest in London, or anywhere else we should think, and that the excursions are made the means of valuable training as well as of conveying solid information.

THE Council of the Institution of Civil Engineers has just awarded the following, among other premiums and prizes:—A Telford Medal and a Telford Premium to Joseph Prestwich, F.R.S., Assoc. Inst. C.E., for his paper On the geological conditions affecting the construction of a tunnel between England and France. A Watt Medal, and a Telford Premium, to Alexander Carnegie Kirk, Assoc. Inst. C.E., for his paper On the mechanical production of Cold. A Telford Premium to Major James Browne, R.E., Assoc. Inst. C.E., for his paper On the tracing and construction of roads in mountainous tropical districts.

THE following is a translation of the telegraphic despatch received in Paris by Gen. Morin from H.M. the Emperor of Brazil:—"Service from Rio de Janeiro to Paris *viâ* Falmouth, June 23, 6 o'clock. Electric telegraph established from Europe to Brazil. In addressing you my congratulations on this victory of science, I beg you to communicate my satisfaction to all your colleagues of the Academy of Sciences, to whom I owe so many marks of good-will. Don Pedro." The Academy immediately replied:—"The Academy, moved by his Majesty's remembrance, offers him its thanks, its respects, and its vows."

WE would strongly urge on our readers' attention the appeal made through the daily papers by Mr. C. R. Markham, F.R.S., on behalf of the Cameron-Livingstone expedition. A letter from Lieut. Cameron, dated Ujiji, Feb. 28, tells of his having secured Dr. Livingstone's map and journal from Mikandany, which he was to send home in a few days. "The fish of Tanganyika," he states, "are more like sea than fresh-water fish. The Tanganyika is a veritable sea. I will send home a bottle of lake-water to be analysed. I cannot understand, receiving as it does rivers that flow through a salt soil, why the waters of the lake should not be salt. I believe that it is gradually being filled up."

THE Report of the Commissioners of Fisheries for the State of New York states that in 1872 upwards of seven and a half millions of young shad were hatched and turned into the river Hudson at the cost of the State; and five millions were added in 1873. In the spring of the latter year, several hundred thousand shad were transported into California and into the great American lakes, where it is hoped they will become fairly acclimatised. The Sacramento River Salmon, and the Whitefish (*Coregonus albus*) have, in return, been introduced from the lakes and rivers of the West to the Eastern States. The enactment of a close time, during which the shad may be allowed to proceed unmolested up stream to spawn, is urgently desired, otherwise the natural increase of the fish can never occur, and the results of the artificial culture and propagation are nullified. The efforts of the Commissioners, who have erected extensive hatching premises at the cost of the State, have resulted in much more light being thrown on the subject of pisciculture. So thoroughly is the process of artificial spawning and fecundation carried out, and so carefully are the after stages of development assisted, that nearly cent. per cent. of the eggs taken are actually hatched. Under ordinary circumstances hardly twenty per cent. of the eggs are hatched. The importance of this system in re-stocking barren or depopulated waters cannot be over-estimated; but its results can never be fully successful until all impediments to the ascent of fish in the spawning season are removed; and when this is the case, artificial propagation will be no longer necessary.

MR. SETH GREEN, the well-known American pisciculturist, proposes that some enterprising persons should turn their attention to frog culture; and he gives careful directions for procuring and treating the spawn and frogs. The spawn will hatch in about fifteen days, and if the tadpoles and young frogs are placed in a suitable position it is calculated that they may be easily reared, and a large profit made. The mode of feeding the frogs is to place pieces of meat, or other substance, to attract the flies, upon which the frogs feed; they will also eat the maggots of decayed meat, and even the meat itself. It appears that the demand for frogs in America is increasing, and in that case a frog-farm might be made a good investment.

Of the 120,000 salmon eggs which were sent from England to New Zealand in the winter of 1872, only about 60 are now alive. Although the ship *Oberon* by which they were sent was only 93 days on the passage, she was delayed on her arrival at Dunedin in consequence of a quantity of gunpowder being on board, which was obliged to be discharged before she could get into port. Probably the eggs were not properly fertilised; though several boxes of ova which were kept packed in ice in England for 108 days under exactly similar conditions, produced a good percentage of fish. The Government of New Zealand intend to repeat the experiment this year, when Glasgow will be the port of despatch.

On July 1 severe thunderstorms were felt in several parts of southern France, principally in and around Montpellier, which seems to have been a centre of electric manifestations. But the harm done was principally owing to the hailstones, which have been numerous and of considerable size, many of them reaching the bulk of a marble. Many crops were damaged, and even in some instances completely destroyed. These hail clouds travelled at a rapid rate from the eastern Pyrenees, near the Rhone, in a north-eastern direction for more than a hundred miles with a breadth of not more than eight or nine miles. A map will be published in the *Atlas Météorologique* of France, which was founded by M. Leverrier in 1864, and was published in 1864-68. The volume for 1869 will be issued shortly, and will contain the most notable facts for 1870-71. The publication, which has been stopped since M. Leverrier left the Observatory, will be resumed yearly henceforth, the Versailles National Assembly having granted the necessary funds. It has been remarked already by M. Charles Martin and the two Becquerels that hailstorms are always connected with thunderstorms, and follow mostly a strongly zigzag line, almost always recurring in a number of chosen spots, for which they seem to feel an irresistible attraction. Woods are very seldom touched by them, a fact which has induced MM. Becquerel to advise farmers to grow trees in order to be protected against hailstones. M. Arago encouraged some years ago a scheme for erecting captive balloons with an iron rod, connected with the earth by an iron chain, in order to provoke electrical discharges and suppress the cause of hail-production. The proposal seems to be rather daring, but the above statements render it desirable that it should at least be tried. Aiming at certain spots in preference to others, the efficiency of protection is sure to be easily tried. M. Colladon, a Genevan physicist, has published many experiments on the fall of lightning on trees. He supposes that poplars are really very attractive, and that they may effectually render the same service as true lightning conductors, if plates of iron are connected with the trunk and earth. These suggestions are very likely to be tried on a grand scale.

Icebergs seem to be unusually plentiful this season; a despatch from New York states that several ships have encountered them in uncommonly large numbers and of very unusual size.

Messrs. Trubner & Co. have in the press "Tea, Coffee, and Cocoa," a practical treatise on the examination of tea, coffee, and cocoa, by Mr. J. A. Wanklyn, M.R.C.S.

Another supplement, No. 37, to Petermann's *Mittheilungen* has just been issued, containing a long account of Carl Mauch's travels in the interior of South Africa in the years 1865-72. The accompanying map illustrates a journey made by Mauch in 1871-72, from Simbabye in 20° 10′ S., and 31° 40′ E. in a north and east direction, to Senna on the Zambesi, in 17° 20′ S., 35° 8′ E.

If anyone wants to see how lamentable is the absence of practical work in the examination system of the University of London, let him get "Questions in Chemistry and Natural Philosophy given at the Matriculation Examination of the University of London from the year 1864 to June 1873, classified according to the syllabus of subjects," by C. J. Woodward, B.Sc. (Simpkin, Marshall, & Co.) We say nothing against the book itself, which is a creditable compilation of its kind, but the system capable of giving birth to such a text-book must be an unmitigated encouragement to "Cram."

A telegram dated Singapore, July 2, states that H.M.S. *Basilisk* had arrived there, having successfully completed a survey of the previously unknown north-eastern shores of New Guinea. Capt. Moresby reports that the existence of a new and shorter route between Australia and China is an established fact.

The additions to the Zoological Society's Gardens during the past week include a Branded Ichneumon (*Herpestes fasciatus*) from West Africa, presented by Lady Sheffield; a Rose-ringed Parrakeet (*Palæornis docilis*) from the Zambesi River, presented by Mrs. Loveday; a Chimpanzee (*Troglodytes niger*) from West Africa; a Spectacled Bear (*Ursus ornatus*) from the Upper Amazon; an Eyra Cat (*Felis eyra*)) from South America; a Nisnas Monkey (*Cercopithecus nisnas*), an Eleonora Falcon (*Falco eleonoræ*) deposited; two Pumas (*Felis concolor*), and nine Rosy-billed Ducks (*Metopiana peposaca*) born in the gardens.

SCIENTIFIC SERIALS

The *Journal of the Chemical Society* for June contains the following papers communicated to the Society:—On the cobalt bromides and iodides, by Walter Noel Hartley. The bromide is prepared by allowing metallic cobalt to stand in a dish with bromine and water for a week or so, when a purple solution is obtained which becomes blue after dilution and filtration. When evaporated over sulphuric acid, purple-red prismatic crystals separate, having the formula $CoBr_2 . 6H_2O$. When heated to 100° the salt loses 4 molecules of water. The iodide obtained in the same manner forms a mass of highly deliquescent green crystals. Heated to 100° in the air a basic salt is produced; on adding water and filtering a red oxyiodide is obtained, having possibly the formula Co_2I_2O. The green crystals have the formula $CoI_2 . 2H_2O$; an iodide, $CoI_2 . 6H_2O$, of a dusky red colour also exists, and likewise the anhydrous salt CoI_2, which is described as a black amorphous substance.—Note on the solubility of plumbic chloride in glycerin, by Charles H. Piesse. The author has made quantitative determinations of the amount of $PbCl_2$ dissolved by pure glycerin and by mixtures of glycerin and water. The mean of two experiments gives 1·995 as the amount of $PbCl_2$ dissolved by 100 parts of glycerin. The solubility is not perceptibly increased by the temperature. Experiments were also made with mixtures containing respectively 50, 75, and 87·5 per cent. of water, and the amount of $PbCl_2$ dissolved agrees very closely in each case with the number obtained by adding the amount of the salt dissolved in the water to the amount dissolved by the glycerin, the solubility in water being taken at 0·733 per cent.—On the products of the decomposition of castor oil. No. 2. The distillation of sodium ricinoleate, by E. Neison. The author's experiments confirm the statements of Bouis, that the sodium salt named yields methyl-hexyl ketone on destructive *distillation*. The results obtained by Stadeler, who got by this reaction only heptylic aldehyde, are explained by a difference in the nature of the soap used.—Note on a reaction of gallic acid, by Henry R. Procter. When a solution of potassic or sodic arsenate is added to one containing gallic acid and the mixture exposed to the air, oxygen is absorbed, and an intense green colour produced. Dilute acids change the colour to purplish red—strong H_2SO_4

and HNO_3, and boiling HCl change it to a pale yellow. The colour is also destroyed by reducing agents.—On ozone as a concomitant of the oxidation of the essential oils. Part I. by Charles T. Kingzett. The author first determined the amount of oxygen absorbed by ether, oil of turpentine, and various essential oils. Various reactions of the so-called ozonised oil of turpentine have been studied. The oxidised substance resembles both ozone and hydrogen peroxide in certain properties, but its aqueous solution retains its properties after long-continued boiling. The substance is destroyed also by MnO_2 and by heating with $ZnCl_2$. The author concludes from his experiment that the supposed ozone is an oxidised compound of the turpentine oil, $C_{10}H_{16}O.H_2O$.—It is much to be regretted that the Society still finds it necessary to advertise on the wrapper of the present number (as also of the last) a list of books missing from the library.

American Journal of Science and Arts, June.—The first article is by W. Hilyard, Univ. of Michigan, On some points in Mallet's theory of vulcanicity. He gives a *résumé* of the state of the question. Among other points considered Mr. Hilyard says:—"While Mr. Mallet's theory accounts satisfactorily for earthquake phenomena and volcanic activity as manifested since the cessation of fissure eruption; and also for the gradual or sudden depression of both large and small areas, even subsequent to that time; it makes no provision for their elevation, and therefore leaves unexplained the numerous oscillations of level of which we find the record down to our own time. In assuming the movements as taking place exclusively within the solid shell, he (unnecessarily, it seems to me) leaves a point open to objection." . . . "At the first blush the 'squeezing out of sub-mountain liquid matter' assumed by Leconte as the consequence of the folding and fissuring of strata by tangential thrust, appears natural enough. Yet it seems hardly possible that the same force which makes and elevates mountain-folds (being the result of interior shrinkage) should at the same time serve to compress the interior liquid, unless either such folding occurs beneath the general level of the liquid; or the latter is locally confined; or the movement is so brusque or cataclysmal that viscosity would prevent the lateral or downward escape of the liquid rock." While the assumption of locally limited fire seas, as proposed by Dana, would remove the difficulty, calculation shows the required size of the seas to be such that they would approach to nearly a general undercrust fluidity.—In the second article Mr. L. Lesquereux replies to Dr. Newberry's objections to the Colorado Lower lignite formation being referred to the period of the Lower Eocene. He shows that many of the species it contains are common to Alum Bay and Mount Bolca, and he objects to Heer's statement that the floras of these two localities have "a distinctly tropical and Indo-Australian character." The next article is a continuation of Mr. C. H. Hitchcock's paper On the Helderberg rocks of New Hampshire. The beds in question border on the line of the Ammonoosuc River in three areas, the Littleton, North Lisbon, and Lyman. Of the fossils Mr. Billings says: "I do not consider the fossils sufficient to decide the age of the rock very closely, but only that it is Upper Silurian or Lower Devonian.' The communication, which occupies twenty pages, is illustrated with map and sections.—A description of a new fossil resin, by O. Loew, named by him Wheelerite. Its formula is C_5H_6O, and it melts at 154° C.—The next article is a completion of Mr. W. M. Fontaine's paper On the great conglomerate on New River, West Virginia. This series, while in some features resembling the lower coal rocks, is distinguished by an almost entire absence of shales. The study of it has led to the consideration, "Does not the successive formation of coal on an extended scale along the south-west border of the Appalachian coal-field, commencing in the Devonian period, point to the existence at this time of a continental mass nearer than the azoic of Canada?"—On a felspar from Bamle in Norway, by G. W. Hawes.—Notes on some fossils in Illinois State Geological Reports, vol. v., by F. B. Meek.—Chemical composition of the wood of Acrogens, by C. W. Hawes. The analyses show that the wood of Acrogens does not differ in ultimate composition from forest trees.—Under the head "Scientific Intelligence," there is a note that a skeleton of a whale (*Beluga vermontana*) has been found at a depth of 12 ft. 6 in. in clay of the Champlain period, at Jacquet River, Dalhousie, New Brunswick.—The flora of the Dakota group of the Cretaceous is, according to Mr. Lesquereux, remarkable for the absence of any European species of the same age.

THE *Geographical Magazine*, July.—This number opens with an interesting sketch of the history of Indian Marine Surveys.—Col. H. Yule, C.B., contributes an abstract from the *Bulletin* of the St. Petersburg Geographical Society of Mr. F. Paderin's account of his visit to the site of Karakaroum in 1873, which is illustrated by a sketch-map.—Another paper by Col. Yule contains some valuable information concerning the wonderfully accurate *Atlas Sinensis* (1655) of the Jesuit Martin Martini.—A number of valuable notes on the Kashgar Mission are given in the form of letters from Lieut.-Col. Gordon and Capt. Biddulph.—Baron von Richthofen sheds considerable light on the question of land communication between Asia and Europe. No one is entitled to speak with more authority than this great explorer of China, and he distinctly states that "the trade-route from Si-ngan-fu, past Hami, to Kuldja, is the best natural line for a railway from China to Europe." He is confident of the practicability of the undertaking.

THE *Journal of Botany*, May, June, July.—The number for May commences with a short sketch of the life of a little-known botanist, William Sherard, a contemporary of Ray, who died in 1728, and bequeathed his library and herbarium to the University of Oxford, together with an endowment of 3,000*l.*, for the Professor of Botany.—Mr. F. A. Lees has a useful paper On the flora of the Yorkshire coal-field.—Prof. Thiselton Dyer appends some remarks to a translation of M. Vesque's paper On new species of Dipterocarpus, from the *Comptes Rendus*, some of M. Vesque's names having a claim of priority over those published by Prof. Dyer in the preceding number of the *Journal*, while others appear identical with previously described species, and to have been published on insufficient grounds.—In the number for June the papers are mostly of a character to interest species-botanists only.—Mr. J. G. Baker describes some new species of Dracæna from Tropical Africa.—The same remark may be applied to the number for July, with the exception of an account of the Botanical Congress at Florence, continued from the preceding number, and reprints of the Official Reports of the Keeper of the Botanical Department of the British Museum, and the Curator of the Herbarium and Library at Kew for 1873.—One or more plates in every number now add to the permanent value of this admirably conducted magazine.

IN the *Scottish Naturalist* for July, we find papers on Scotch zoology, phytology, and geology. We would call special attention to one by Mr. G. Sim, On the food and use of our rapacious birds, an eloquent appeal for the protection of our "Raptores," which are now becoming scarcer every year. From an examination of the stomachs of 305 birds which have passed through his hands during the last ten years, eagles, buzzards, ospreys, falcons, merlins, kestrels, sparrow-hawks, owls, &c., the author has come to the conclusion that the injury done by these birds to the farmer and game-preserver is very small compared to the benefit, by far the most abundant articles of their food being mice, shrews, and various insects. Even when hawks do kill game, he maintains that it is the weakly and sickly birds that fall victims.—Mr. F. Smith concludes his paper On the geology of the Earn Valley, and Dr. Buchanan White and Dr. Sharp give further instalments of the Lepidoptera and Coleoptera of Scotland.

THE *Transactions of the Linnean Society* has now entered on its thirtieth volume. The first part, just published, contains Mr. J. Scott's paper On the tree-ferns of British Sikkim, illustrated with eighteen plates; a paper On some recent forms of *Lagena* from deep-sea soundings in the Java seas, by F. W. O. Rymer-Jones, with one plate; an enumeration of the Orchids collected by the Rev. E. C. Parish near Moulmein, by Prof. H. G. Reichenbach, f., with six plates; and a most elaborate and laborious monograph of the habits, structure, and relations of the three-banded armadillo, *Tolypeutes conurus*, by Dr. James Murie, with seven plates.

Memorie della Società degli Spettroscopisti Italiani, May.—Secchi and Tacchini contribute a table showing the solar prominences for November and December 1872, in which there is a marked aggregation of prominences on either side of the solar equator and a total absence at the poles.—There is also a coloured plate of some prominences and faculæ, by Gautier.—Schiaparelli gives an account of Capt. Tupman's observations on shooting stars, accompanied by a table showing the length of the trajectory in degrees and duration of numbers of meteorites.—Lorenzoni gives a discussion of the results of the researches at the Vienna University on the orbits of meteorites, with a table showing the elements of sixteen meteor streams.—Prof. Bredichin gives his solar observations for last autumn, together with a discussion on the formation of prominences.—Tacchini gives his observations on solar spots for May 1874.

Astronomische Nachrichten, No. 1,997.—This number contains an account of the observations of the minor planet Virginia since its discovery in 1857, and the following elements are calculated :—

1874, June 19, Berlin.

$$\begin{array}{rcrrr} & & {}^{\circ} & {}' & {}'' \\ M &=& 322 & 19 & 49\cdot80 \\ \pi &=& 10 & 0 & 42\cdot76 \\ \Omega &=& 173 & 27 & 39\cdot0 \\ i &=& 2 & 47 & 53\cdot5 \\ \phi &=& 16 & 37 & 4\cdot3 \\ \mu &=& \multicolumn{3}{l}{822''\cdot710835} \\ \text{Log.}\ a &=& \multicolumn{3}{l}{0\cdot4231729} \end{array}$$

An ephemeris is also added for the opposition this summer.—Doberck contributes new elements for Comet I., 1824, deduced from Rümker and Sir J. Brisbane's observations.—Some observations of position of Henry's Comet, 1873, are given by J. J. Plummer.—No. 1,998 contains a paper on the photographic processes applicable to the transit of Venus.—C. S. Sellack contributes a paper on the direct photography of the solar protuberance.—A communication on the elements of the orbit of Alceste is made by A. Hall, corrected by observations made at Washington.—M. Flammarion gives the following periods of double stars :—

	Years.	Apparent semi-axis major.	Perihelion passage.
ξ Ursa Majoris . .	60·60	2″·45	1873·40 at 358°
ζ Herculis	34·57	1·19	1864·35 at 298
η Corona Bos . . .	40·17	0·865	1853·95 at 287
γ Virginis	175·	3·385	1836·45 at 320

No. 1,999.—This number contains an ephemeris of the five inner satellites of Saturn from June 1 to Oct. 28, by A. Marth, and a discussion of the various theories of comets, by W. Zenker.—In No. 2,000 is an account of some spectroscopic observations on certain variable and other stars, by H. C. Vogel; the author gives the wave-lengths of the lines in some cases.—G. Strasser gives a number of observations on comets (Winnecke and Coggia), together with the list of comparison stars.—C. H. F. Peters contributes observations on some of the planetoids, and A. Kruger gives some position observations of Coggia's comet.

Justus Liebig's Annalen der Chemie und Pharmacie, Band 172, Heft 1. This number contains the following papers :—A condensation product of glyoxal, by Hugo Schiff. Glyoxal is dissolved in five or six volumes of strong acetic acid and a stream of hydrochloric acid gas passed through the solution for about fifteen minutes. The solution on standing deposits a white substance, which was found to possess the composition $C_{12}H_{14}O_{12} = 6C_2H_2O_2 + H_2O$, and which the author proposes to name *hexaglyoxal hydrate*. Treated with acetic anhydride, one atom of hydrogen is replaced by acetyl, giving the compound $C_{12}H_{13}(C_2H_3O)O_{12}$; similarly with benzoyl chloride the compound $C_{12}H_{13}(C_7H_5O)O_{12}$ is produced. The author concludes from these reactions that the substance contains *one* semi-molecule of hydroxyl.—Improved air-bath for heating sealed tubes, by J. Habermann.—On the oxidation products of amylum and paramylum with bromine, water, and oxide of silver, by the same. Amylum yields dextronic or glucosic acid $C_6H_{12}O_7$, and paramylum the same. The calcium, barium, and cadmium salts of the acids were examined.—On the sodium contained in the ashes of plants, by G. Bunge. The author is of opinion that the result obtained by Peligot, who found that the ash of beans was free from sodium, is due to some error in the method of determination employed. An examination of the analytical method employed by Peligot has been undertaken, the results of the analysis of the ash of cows' milk being given as an example. This examination leads the author to the conclusion that by determining the alkalies merely in the aqueous extract of the ash, not only is a low value obtained, but the ratio between the two bases is a false one. Details of the method of analysis adopted are next given, and its application to the ash of beans, clover, meadow grass, apples, and strawberries. The author remarks that by his analyses Peligot's conclusions are not refuted, but at the same time they cannot be considered as established on the grounds of the analyses made by that chemist.—On oxysulphobenzide and a new derivative of this substance, by Dr. J. Annaheim. The following substances are described in this paper :—Oxysulphobenzide, $\left(\begin{matrix}C_6H_4HO\\C_6H_4HO\end{matrix}\right\}SO_2\Big)$; Phenoltrisulphonic acid, $\begin{matrix}HO\\C_6H_2SO_3H\\(SO_3H)_2\end{matrix}$; Tetrachloroxysulphobenzide, $\left.\begin{matrix}C_6H_2Cl_2OH\\C_6H_2Cl_2OH\end{matrix}\right\}SO_2$, and the corresponding bromine and iodine compounds; methyloxysulphobenzide, $\left.\begin{matrix}C_6H_4OCH_3\\C_6H_4OCH_3\end{matrix}\right\}SO_2$; the dinitromethyl compound, $\left.\begin{matrix}C_6H_3NO_2OCH_3\\C_6H_3NO_2OCH_3\end{matrix}\right\}SO_2$; the diamido compound, $\left.\begin{matrix}C_6H_3NH_2OCH_3\\C_6H_3NH_2OCH_3\end{matrix}\right\}SO_2$; the ethyl compound, $\left.\begin{matrix}C_6H_4OC_2H_5\\C_6H_4OC_2H_5\end{matrix}\right\}SO_2$ the corresponding amyl compound, and their nitro-, amido-, and brominated substitution derivatives.—The concluding paper is by Otto Hecht and Julius Strauss: On normal hexylene and some of its derivatives. The authors have examined the dibromide $C_6H_{12}Br_2$, and the monobromide, $C_6H_{11}Br$.—A plate illustrating Habermann's paper On an improved air-bath accompanies the present part.

SOCIETIES AND ACADEMIES

LONDON

Anthropological Institute, July 1.—Special meeting at the East London Museum, Bethnal Green.—Prof. Busk, F.R.S., president, in the chair.—Col. Lane Fox read a paper on the principles of classification adopted in the arrangement of his anthropological collection exhibited in the East London Museum. The paper contained three divisions, viz. Psychological, Ethnological, and Prehistoric. The author's object had been, during the twenty years he had been occupied in forming the collection, to select the specimens not so much for their rarity or beauty as for their utility in illustrating the succession of ideas by which the minds of men in a primitive condition of culture had progressed from the simple to the complex. Contrary to the usual system of arrangement, which was geographical, and was to be found in most ethnographical museums, the author's primary arrangement had been guided by form, *i.e.* spears, bows, clubs, &c. had been placed by themselves in distinct classes; and within each class there were sub-classes for special localities, and in each of the sub-classes the specimens were arranged according to their affinities. It was shown how far the arts of existing savages might be employed to illustrate the relics of primeval men. In studying the evidence of progress, the phenomena that might be observed were (1) a continuous succession of ideas; (2) the complexity of the ideas in an increasing ratio to the time; (3) the tendency to automatic action upon any given set of ideas in proportion to the length of time during which the ancestors of the individual have exercised their minds in those particular ideas. After a lengthened elaboration of those psychological considerations Col. Fox pointed out that the forms of implements used by savage races, instead of affording evidence of their having been derived from higher and more complex forms, showed evidence of derivation from natural forms, such as might have been employed by man before he had learned the art of modifying them to his own use; and that the persistency of the forms is in proportion to the low state of culture. That conclusion was illustrated by reference to the Australian and other savage peoples. The third and concluding part of the paper was devoted to the correlation of modern implements in use among existing savages with those of Prehistoric times.—The reading of the paper was followed by an explanation of the collection, which was arranged with a view to illustrate the principle of sequence contended for by the author.

PHILADELPHIA, U.S.

Academy of Natural Sciences, Dec. 23.—Dr. Ruschenberger, president, in the chair.—Prof. Cope made some remarks on fishes from the coal measures at Linton, Ohio. He stated that Prof. Newberry, Director of the Geological Survey of Ohio, had sent to him numerous specimens of fishes and batrachians for determination and description. Among these he had discovered batrachians which were labelled and had been described as fishes (*Pygopterus scutellatus* Newb.), and fishes (*Conchiopsis* and *Peplorhina* Cope) some of which were labelled "Amphibian or Reptilian." Having determined the latter to be fishes and described them, he called attention to a note of Prof. Newberry on the latter, in which he states (1) that *Peplorhina anthracina* is a batrachian; (2) that it is identical with *Conchiopsis exanthematicus*; (3) that *C. filiferus* is *Cœlacanthus elegans*; (4) that the dentition described by him is not that of *Cœlacanthus*; and that (5) the genus is the same as that described by Agassiz forty years ago as *Cœlacanthus*. To these propositions Mr. Cope replied that (1) additional evidence derived from two specimens of *Peplorhina anthracina*, recently studied, confirms the view that it is a fish, which evidence is given below; (2) that neither of the two specimens exhibits in its cranial bones the characters of *C. exanthematicus*, though both sides are exhibited. They show, however, that the latter should be referred to the genus *Peplorhina*, since among other points they present the same type of teeth, which I find labelled on one of them "ova?" (3) Mr. Newberry's identification of the species *C. filiferus* with *Cœlacanthus elegans* is doubtless correct; but (4 and 5) its reference (with that of similar species) to Agassiz's genus is not warranted until it is found to possess an osseous natatory bladder, and osseous ribs and the type of dentition are discovered in *Cœlacanthus granulatus*, the type of the genus. The characters relied on as indicative of the reference of *Peplorhina* to the fishes, are (1) the presence of opercula like those of *Conchiopsis*; (2) the presence of jugular bones, and (3) of oval imbricated scales; (4) the absence of ambulatory limbs. The thin scutiform cranial bones, the dense patch of vomerine teeth, and the mucous ducts of the bones and scales were all ichthyic characters. As no limbs had been discovered in three specimens preserved in the appropriate regions, their nature, if existing, could not be determined at present.—Prof. Cope brought before the Academy some results derived from study of material obtained by him during the preceding summer in the Miocene formations of Colorado. He announced the discovery of the first fossil monkey of the Miocene of America, giving it the name of *Menotherium lemurinum*. He regarded it as allied to the *Tomitherium* of the Bridger Eocene, and as the representative of the more numerous group of the lemuroids, which he had discovered in the latter formation. Size, that of a domestic cat. He stated that his recent discovery of snakes, lizards, and lemurs of forms allied to those previously discovered by Prof. Marsh and himself in the Eocene of Wyoming, constituted points of affinity to the fauna of that period not previously suspected. He also observed that he had discovered some additional species of *Ruminantia* allied to the musk, and to the *Leptomeryx evansii*, which he named *Hypisodus minimus*, and *Hypertragulus calcaratus*, and *H. tricostatus*. The first was the least of the order, not exceeding a cat-squirrel in size. *Hypertragulus* differs from *Leptomeryx* in the isolation of the first premolar, as in the camels, and in the sectorial character of the penultimate premolar.—On circulatory movement in Vaucheria. Prof. Leidy made some remarks on the intracellular circulation of plants, as exemplified in the hairs of the Mullein, the leaf-cells of Vallisneria, &c. The moving streams of protoplasm he likened to amœboid movements, and expressed the opinion that they were of the same character. In the common alga, *Vaucheria*, the filaments of which consist of very long cells, comparable to those of Nitella or Chara, he had observed an apparent motion of the cell contents, which is somewhat peculiar and, at least, is not generally mentioned by writers. The wall of the cells is invested on the interior with a layer of tenacious protoplasm, containing the thinner liquid cell contents as usual. The parietal protoplasm is closely paved with green granules, and these appear very slowly but incessantly to change their position in relation with one another. The motion is so slow that it was a question for some time whether it did actually occur, but it appears sufficiently obvious if observed in relation with the lines of a micrometer, and its existence was confirmed by several friends whose attention was directed to it.

Paris

Academy of Sciences, July 6.—M. Bertrand in the chair.—The following papers were read:—Presentation of a specimen of the photographs of an artificial transit of Venus obtained with the "photographic revolver," by M. J. Janssen.—Researches on solution, crystallisation, precipitation, and dilution, by M. Berthelot. This is a continuation of the author's important researches in thermo-chemistry. The thermal effects accompanying coagulation, the transformation of an amorphous into a crystalline substance, and the mixture of two saline liquids are now treated of. A differential method for measuring the specific heats of dilute solutions has been introduced.—On parasitism and contagion, by M. Ch. Robin.—M. Dumas made some remarks in reply to the foregoing paper.—On the spectrum of Coggia's comet, a letter from P. Secchi to the perpetual secretary. The author has observed that of the three carbon bands the green is the brightest, while in Tempel's comet the yellow was the brightest, a fact which proves that the gaseous combinations are not rigorously the same for all comets. It was further stated that at the beginning of the month only the band spectrum was visible, but now a general line of connection exists, forming a quasi-continuous spectrum through the centres of the bands. A drawing of the spectrum accompanied the paper.—On the photographic apparatus adopted by the Transit of Venus Commission: reclamation of priority; extract from a letter from Col. Laussedat to M. Dumas.—On the method of employing carbon disulphide in the treatment of vines attacked by *Phylloxera*, by M. Fouque.—In mathematical analysis:—On osculatory surfaces, by W. Spottiswoode.—Note on orthogonal surfaces, by M. E. Catalan, and Reply to the observations of M. Combescure, by M. l'Abbé Aoust.—M. Prazmowski presented (through M. Janssen) a note on the helioscope. This instrument is designed by the author for diminishing the brilliancy of the sun's image by polarisation.—On the diffusion of light and the illumination of transparent bodies, by M. J. L. Soret. By examining quartz, amethyst, diamond, and other crystals, the author has concluded that the illumination of non-fluorescent transparent crystalline substances is always due to want of homogeneity.—On the formation of solar spots, by M. Tacchini. The author sees no confirmation of the cyclone theory of sun-spots in the detailed observations of the chromosphere made in Italy, America, and England. Some solar observations for June were also communicated, from which it appears that the sun was in a state of great activity during that month. On the 11th Mg. was reversed all round the sun's limb: on the 4th two double lines (4,924-5,018) were reversed on the western limb, and on the 11th they occupied nearly all that limb and encroached upon the eastern border. A great eruption took place on the 10th, when all the lines from *b* to 1,474 were seen reversed.—Researches on electric transmission through ligneous bodies, by M. Th. du Moncel. The author's experiments show that wood owes a considerable portion, if not all, its relative conductivity to moisture contained in the pores.—On the embryology of *Rhizocephalus*, by M. A. Giard. These animals constitute a Cirrhipedian group.—On the male accessory glands of some animals and on the physiological rôle of their product, by M. P. Hallez.—On the movement of the stamens of *Sparrmannia africana* L., of *Cistus* and of *Helianthemum*, by M. E. Heckel.—On the existence of diatoms in different geological formations, by M. l'Abbé Castracane.—Carboniferous limestone of the Pyrenees. Marble of Saint-Béat and of Mont (Haute Garonne), by M. F. Garrigou.—A neolithic flute, by E. Piette.—On a scab of the horse of intermittent character caused by an acarus, presenting the singular peculiarity of being psoric during winter, and simply parasitic during summer, by M. Mégnin.—Experimental researches on the action of water injected into the veins, from the point of view of pathogeny and uremy, by M. Picot.—Analyses of beers and malts, by M. Ch. Mène.—On the extraordinary hailstorm which fell in the department of Hérault during the night of June 27–28; extract from a letter from M. J. Gay to M. Ch. Sainte-Claire Deville. The loss of vines is stated to be valued at 50,000,000 francs.

CONTENTS

Page
Science in the Showyard 199
Colonial Geological Surveys. II. Victoria. By Prof. A. Geikie, F.R.S. 200
The Fisheries of New England 201
Baldwin's "Irish Farming" 203
Our Book Shelf 204
Letters to the Editor:—
  The Degeneracy of Man.—Prof. Oscar Peschel; E. B. Tylor, F.R.S. 204
  Photographic Irradiation.—A. C. Ranyard; W. J. Stillman 205
Observatories in the United States, II. (*With Illustrations*) . . 206
The Relations between Human Mortality and the Seasons of the Year 210
Conference on the Registration of Periodical Natural Phenomena. 210
The Spectrum of the Aurora Borealis 210
The Comet (*With Illustration*) 212
Jasper's "Birds of North America" 212
Notes 213
Scientific Serials 215
Societies and Academies 217

THURSDAY, JULY 23, 1874

THE PUBLIC SCHOOLS COMMISSION

THE claims of science to form an integral part of a liberal education are, without doubt, making progress. Readers of the early numbers of NATURE will remember how it was, with justice, complained that scarcely a single Scholarship or Fellowship was to be obtained at the old Universities for science alone. In more recent numbers the statement has to be modified—there is not yet a sufficient proportion. Now it is acknowledged on all hands, that the teaching of a subject at school and its recognition at the Universities are inseparably connected—and especially with regard to science. The Colleges say, We cannot give more scholarships, because a sufficient number of men of good attainments do not present themselves; and the Schools reply, We cannot spend our time on subjects for which there are so few rewards. Both profess willingness, but each calls on the other to take the initiative. One might, perhaps, be inclined to wonder that this question of pecuniary rewards should be of so much consequence as consciously to override the acknowledged main object in view—that of giving the best possible education. But it must be remembered that scholarships at the Universities are the honours of a school—the only means it has of showing to the world that it is doing its work well.

The progress due to the stimulus of scholarships is from these reasons slow, though perceptible; and the friends of science have been looking therefore to the Royal Commissions on Scientific Instruction, and on the Public Schools, to supply a stimulus from another quarter.

The proposed "Regulations" of the latter Commission which have just been issued will be welcomed by those who heartily wish for the progress of Science Teaching. Ignoring, of course, the question of University scholarships, they indirectly settle it by placing science on exactly the same level as mathematics, and enforcing the necessary outlay for its efficient teaching. And there can be little doubt that this is the right end at which to begin the reform, for it is a narrow view to consider the Universities as making the demand by offering rewards, and the schools as affording the supply. It is the public that demand scientifically educated men, and the schools first, and then the Universities, are called upon to supply them.

These Regulations apply, of course, to a very limited number of schools, some of which have already done much that is now required of them; but they are the most important schools in the kingdom, and will inevitably influence all others by the standard thus set. If these Regulations be confirmed the nail will be driven home, and science will be established as a necessary part of every public school curriculum.

The following are the Regulations to which we especially draw attention, and which are common to all the schools in the view of the Commission:—

"2. In every examination determining the position of a boy (not being one of the senior boys) in the school, or in any report of a general examination, the proportion of the marks to be assigned to mathematics shall be not less than one-eighth, nor more than one-fourth, as the governing body may think fit.

"3. In every examination determining the position of a boy (not being one of the senior boys) in the school, or in any report of a general examination, the proportion of the marks to be assigned to natural science shall be not less than one-eighth, nor more than one-fourth, as the governing body may think fit.

"4. In any examination for the senior boys, the proportion of the marks to be assigned to the several subjects of study shall be determined by the head master, with the approval of the governing body.

"5. The governing body shall from time to time determine the point in the school list above which the boys shall be reckoned as senior boys for the purposes of these regulations.

"6. The head master shall give facilities so far as practicable to any senior boy, at the request of his parent or guardian, to pursue any particular subject or subjects of study as may be deemed most expedient for him, and to discontinue any other subject or subjects of study for that purpose.

"7. The governing body shall, as soon as possible, provide and maintain out of the income of the property of the school, or out of any other means at their disposal for the educational purposes of the school, laboratories, and collections of apparatus, and of specimens."

It will be observed that the wording of Nos. 2 and 3 is identically the same, except the substitution of the words Natural Science for Mathematics—thus placing these two subjects upon exactly the same level. With regard to the limits one-fourth and one-eighth, taking it as approximately correct that the proportion of marks in an examination will be that of the time devoted to the subject, these two together will require at least one-fourth of the whole time, a larger proportion than is now given to mathematics in most schools, especially with those who are not "senior boys;" and thus an encroachment on the classical time is involved, and this lower limit is not likely, therefore, to be much exceeded, in these great schools at all events. But even this will insure greater breadth than under the old system, and will secure that every boy shall know something of the elements of science before he goes on to the elegancies of classics.

The individual character, however, of particular schools is not interfered with, for this depends essentially on the work of the senior boys; and for them by Regulation 4 the head master may arrange the marks to suit the old traditions of the school. Yet, when we consider the effect of Nos. 6 and 7, we may doubt whether the individuality will continue so well marked. For with laboratories to work in, and specimens to handle, and facilities to pursue their favourite subject, it is impossible but that some fair proportion of the scholars should be attracted by the charms of physical investigation or of natural history, and mix the honours of the school.

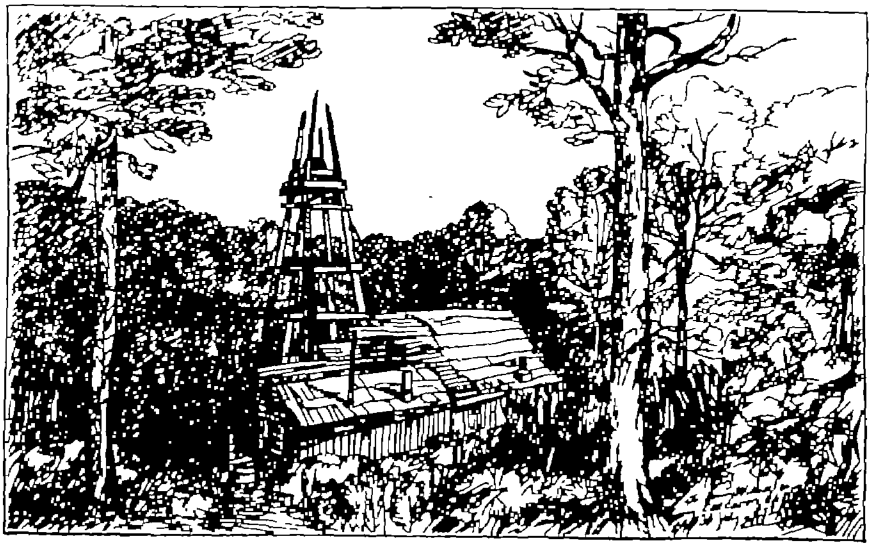
Of all the proposed Regulations, however, the most pregnant with consequences is the last.

There is no need surely in these days to insist on the absolute necessity for "laboratories and collections of apparatus and of specimens," if science is to be taught at all; and we may look, therefore, on this as simply the definition of the term "Natural Science;" it is not book learning, but science learnt from Nature herself by practical work. If a governing body be called on to provide such laboratories, we may rely on it that for the credit of their school they will do it well, and a good laboratory leaves only a good teacher to be desired, and itself helps to form and train him. The confirming of this Regulation will be a great step towards that much-to-be-desired state of things when a laboratory will be considered as necessary a part of a school as a class-room, bottles and bones as essential as books and boards. But we must not ignore what has already been done in schools like Eton and Rugby; with their laboratories and museums, such a Regulation is superfluous; but with the good work which has been accomplished before us, we have a happy omen of the result of the universal application of the principle they have voluntarily adopted. It is from these schools and others not included in the "nine," that have not fitted up their laboratories, that the Natural Science scholars are obtained, and perhaps the proportion of such scholarships to all others is as great as that of schools with laboratories to those without—probably greater. As the number of science-teaching schools increases the number of scholarships must increase too, but not at the same rate; the proper and final proportion may be left to settle itself.

On the whole we may regard these proposed Regulations with the greatest satisfaction, and it is probable that they will be looked back upon as the charter of the country's progress in scientific education. Individual efforts have been made on a grand scale, and natural science is making its way more or less efficiently into all good schools, while some are devoting themselves chiefly to its cultivation, as Taunton, Giggleswick, Burnley; but universal recognition, its acquirement of *prestige*, and consequent respect and earnest study, with the national advantages to be derived from it, can only be secured by such Regulations as these, followed or not as may be necessary, by similar ones for all the larger endowed schools.

THE SUB-WEALDEN EXPLORATION

IF the word *romance* were to be imported into scientific literature there could surely be no more fitting application of it than to this recent crusade into the bowels of the earth among the woods and lanes of Sussex. Down in that southern part of the country, some hundreds of miles away from the great centres of our mineral industry, with no prospect of any pecuniary reward or of any immediate economic advantage, men are found willing to subscribe money to the extent of thousands of pounds for the purpose of settling definitely some important questions in the geology of the south-east of England, viz. at what depth from the surface the secondary strata are underlain by a ridge or platform of old Palæozoic rocks, what are the nature and age of these bottom rocks of the district, and what is the arrangement of the strata lying between them and the surface. It has long been a problem of much interest to geologists to discover whether or in what manner the great series of Jurassic rocks, which stretches across our island from the coasts of Dorsetshire to those of Yorkshire, passes south-eastward underneath the chalk. That series has been found to grow thinner towards the south-east. On the French side of the Channel it reappears in the Boulonnais, coming out from under the Cretaceous strata and resting against a ridge of Palæozoic rocks which rise to the surface between Boulogne and Calais. Nearly twenty years ago Mr. Godwin Austen drew attention to the probable extension of this ridge underneath the later formations of the south-east of England and its connection with the Carboniferous tracts in our south-western counties. It was a point of great interest in any attempt to reconstruct a map of the physical geography of western Europe during Palæozoic times. Hence, at intervals since the publication of Mr. Austen's great memoir, renewed attention has been given to the subject, until at last the idea took shape that a bold attempt should be made to settle some portion at least of the problem by putting down a bore and keeping it going, if possible, until all the Secondary rocks should be pierced and definite information should be obtained as to what lies below them. Advantage was taken of the meeting of the British Association at Brighton in 1872 to organise the scheme. For so purely scientific a project it was of course natural to look for help mainly to such well-wishers


The Sub-Wealden Exploration in Sussex—Boring at Netherfield. (Kindly lent by the Proprietors of the *Graphic*.)

to science as attend the Association meetings, rather than to the general public. Subscription lists were opened and money came in, not in overflowing abundance indeed, but yet in quantity sufficient to enable the operations to be begun. Further donations have been given, and the work has now been carried down to a depth of more than 1,000 ft.

It would be a great misfortune to science if this undertaking, after having been successfully carried so far, were now to be brought to an abrupt close for want of funds. Already the boring has put us in possession of some new and important facts in the geology of the south-east of England. It has shown that the well-known Kimmeridge clay stretches underneath the later Secondary rocks as a deep massive formation, some 700 ft. in thickness, and that it lies upon and appears to pass down into the Oxford clay without the intervention of the sandy and calcareous beds which usually separate the two deposits. The geological position of these clays is settled by means of the fossils, of which literally thousands have been taken out of the 2-in. core of rock brought up by the diamond-boring machine. It is intended, we believe, to sort the specimens and distribute them among different public museums. How much further the bore must be sunk before the remainder of the Secondary strata is pierced, to what horizons these strata will be assignable, and what will be their basement rocks, are the parts of the problem still to be solved.

Though undertaken chiefly in the interest of pure science, the project has likewise its economic aspects. It is eminently desirable to know whether any minerals of value lie among the Secondary rocks of the south of England, such as iron-stone, rock-salt, or gypsum; whether among the Palæozoic rocks underneath there is any possibility of obtaining workable coal or any of the other minerals which have made the Carboniferous formations so valuable a source of our wealth. It is likewise greatly to be wished that as full and accurate information as possible should be obtained regarding the nature of the rocks underneath with reference to the question of water-supply—a question which, important enough now, is certain before many years to become one of the most pressing social problems of the day.

On every ground, therefore, this most heroic attempt to provide data for settling some of these questions deserves hearty encouragement. On no account must it be allowed to come to an end till its express object is accomplished. If every well-wisher to science in this country would but send his contribution, not only would the present boring be conducted to a successful issue, but a great series of similar borings might be made all over the south of England. We understand that the Government, impressed with the interest and importance of the subject, has promised to contribute a sum of 1,000*l.* conditionally upon coal being found or on the boring being continued for another 1,000 ft. This aid will be valuable, but it evidently in the meantime does not supersede private efforts; it rather makes them more needful than ever. The undertaking is in excellent hands. Mr. Topley, of the Geological Survey, looks after its geological aspects. To Mr. Henry Willett, of Arnold House, Brighton, the zealous and indefatigable honorary secretary, the enterprise is mainly indebted for its financial progress so far. He has now appealed earnestly for further help, and to him we would urge all who take interest in these matters, and who have not already contributed, to send their donations, which, whether small or large, will at the present moment be of the most essential service.

A. G.

THE SCIENCE OF PAINTING

Die Farbenlehre im Hinblick auf Kunst und Kunstgewerbe. Von Prof. Wilhelm von Bezold.

THERE are two ways of popularising science. We may take up one of its great branches and treat it so simply and clearly that even the unscientific reader may with proper attention gain some insight into the principles to which the recent great advances in science have been chiefly due; or we may take up a smaller field and treat it fully and with all its applications in everyday life. He who studies a subject by the latter method will have it constantly brought under his notice, and will thus be led to observe and perhaps to experiment, and to acquire for himself that method of looking at the phenomena of nature and reasoning about them which is necessary to the understanding of every great principle in science, but which is foreign to nearly all who have not had a scientific training.

The latter method, which no doubt will prove the most successful, has been chosen by Prof. von Bezold in his work on the theory of colours. No subject is better fitted to be treated in this way, because it is in everybody's power to make observations, and perhaps even to find out some new fact. It is, however, not the only, and not even the chief, object of the author to create merely an interest in his subject outside the scientific world. He wishes his book to be of real value to the artist and to help him by theoretical speculations to such combinations of colour as shall prove most effectual. It is very doubtful whether the book will be successful in this respect. No doubt it would be a great achievement if every artist could be induced to think about the cause of the various and curious effects which are brought about by contrast and combination of colours; we therefore recommend the careful perusal of Prof. von Bezold's book to every painter. In the present state of the theory of colours, however, the attention bestowed upon it by artists will be of greater value to the subject than to themselves. It would no doubt be injurious to art if the painter were guided in his work by a theory so long as that theory is incomplete.

Painters are, however, themselves best able to bring the theory of colours into a better state; a state in which it will be beneficial to themselves and repay them for their trouble.

Two things have chiefly struck us in Prof. von Bezold's book as adding to its value and interest. The first is the care which he has taken to give his experiments in such a way that anyone without the use of large and expensive apparatus can repeat them and test for himself the truth of the author's statements. The second is the great ingenuity with which the author explains by his theory so many of the phenomena which most of us daily observe. We note one particular instance. All who have worked much at absorption spectra must have been struck by the change of colour which light of a certain wave-length undergoes when the intensity diminishes. Prof. von Bezold uses this curious fact to explain the peculiar colours seen in a landscape when viewed by moonlight, although the light reflected by the moon is identical in composition with sunlight.

In his account of the elementary principles of optics the author abandons the old method of dividing vibrations into heat rays, light rays, and actinic rays. We note this point as it is one which must soon play an important part in physics and will doubtless provoke much discussion. The author seems to prefer the following method of viewing the facts to the old one:—A body absorbs a certain class of rays peculiar to itself; whether these rays are converted into heat or into chemically active rays depends upon the peculiar properties of the body. In order, however, to include in this statement all the facts included in the old division, we must add that, as a rule, bodies absorbing the ultra-violet rays are thereby rendered more chemically active, and, as a rule, bodies absorbing the red are thereby heated. This method of looking at the matter seems to us to be the one most closely agreeing with the facts. Prof. von Bezold gives, as a proof that the red rays may be chemically active, the fact that, as the green colouring matter of leaves absorbs the red end of the spectrum as well as the blue, the red rays alone are sufficient to sustain life in the plant. He might have referred to the recent discovery of Vogel, who photographed the red end of the spectrum by mixing a red colouring matter with bromide of silver; and, on the other hand, to the fact observed by Budde, that chlorine is heated by the ultra-violet rays. The third chapter contains a short and clear abstract of recent researches on compound and primary colours. We would call attention specially to the passage in this chapter on colour and sound, in which the author refers to the influence of dwelling too much on the analogy between sound and light. Analogies are a very dangerous help to teachers, and are used by far too often. It requires at least a partial knowledge of the subject to see where the analogy begins and where it ends. Students generally either do not see where the analogy really lies, or want to carry it too far; a good many erroneous notions are thereby acquired.

The most interesting chapter in the book, however, is the one on Contrast of Colours; the examples are well chosen, and the coloured illustrations in the accompanying plates are in all cases convincing. The author shows with great success how little we may trust our own eyes as regards colour, and how difficult and even impossible it is to form a correct judgment of the relative darkness of two shaded fields, so long as they are not on the same ground.

The last chapter, which treats of the combination of colours, is necessarily the least complete; it shows, however, that the application of the theory to the arts has fairly begun. It has already been said that this beginning does not justify us in demanding from painters obedience to rules which have not been proved to be valid without exception. It may be easy to discover the application of these rules in acknowledged masterpieces, and yet be difficult to state them in such an exhaustive way that compliance with them will in all cases lead to perfect harmony. So long as this is not done it must not be expected that the painter will derive substantial help from the theory of colours.

ARTHUR SCHUSTER

OUR BOOK SHELF

Illustrations of the Principal Natural Orders of the Vegetable Kingdom. Prepared for the Science and Art Department of the Council of Education. By Prof. Oliver, F.R.S., F.L.S. (London, Chapman and Hall, 1874.)

FEW books published of late years will be of greater practical value to the botanical teacher or student than this. The want has long been painfully felt of a work which will give in as few words as possible the salient characters of each of the more important natural orders, unencumbered by minutiæ of structure which concern only the more advanced student. This want we have here most admirably supplied, not only by 150 pages of text, but by upwards of 100 plates, which present in the most lucid form a representation (plain or coloured, as may be preferred) of a section and "diagram" of a flower belonging to many orders, together with a drawing of the fruit, seed, or other organ the structure of which is of special importance. The very comprehensive title of the work might, unless the contrary is pointed out, lead to a little disappointment, when it is found that the descriptions, and still more exclusively the plates, refer almost entirely to the more important *European* orders; very brief accounts, or in some cases none at all, being given of such remarkable extra-European groups as the Cycadeæ, Gnetaceæ, Proteaceæ, Bignoniaceæ, Piperaceæ, and others. As far as European botany is concerned, we cannot conceive that the work could have been better carried out. The plan which has been adopted of treating separately groups which are united together into a single order in our more advanced text-books—as for instance Fumariaceæ as distinct from Papaveraceæ; Oxalideæ and Tropæolaceæ from Geraniaceæ, and Droseraceæ from Saxifragaceæ—seems to us altogether commendable in a work designed especially for beginners. There has long been felt a desire that in text-books of botany the morphological and physiological portion should be divorced from the systematic and descriptive. We trust that in future this may be carried out, and that writers of text-books will confine themselves to the former branch, leaving the student to gain his elementary knowledge of the latter branch from special works like the one before us.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Photographic Irradiation

IN answer to Mr. Ranyard (NATURE, vol. x. p. 205), I have to state that the opaque bar in my experiments was placed as close to the collodion as possible without touching it, not farther than ·01 in. from it, and that there were no photographic traces of diffraction bands.

Allow me now to suggest a possible explanation of the different results given by Mr. Ranyard's and my own experiments. One important difference in the arrangement of the two experiments was, that in the one case the opaque bar was in contact with the collodion, and in the other case it was placed at a very short distance from it. In the experiments with the bar in contact with the collodion, the nitrate of silver solution on the surface of the plate would not form a true plane but would be curved upwards at the edge of the bar; and further, this curve would not be regular, but would have irregularities corresponding to every irregularity in the edge of the bar. This irregular curved fluid surface would cause irregular refraction of the light falling at the edge of the bar, and would give rise to bright and dark parts on the sensitive surface; the bright parts would be extended by molecular irradiation underneath the opaque bar, and would give rise to the irregular brushlike projections mentioned by Mr. Ranyard, instead of the uniform extension obtained when the bar is kept a short distance from the collodion. It is also possible that the irregular curved fluid surface may at certain points, where the bar was not in actual contact with the collodion, have bent the rays of light underneath the bar and given rise to the irregular extension of the image. JOHN AITKEN

Darroch, Falkirk, July 18

I MUST confess myself at issue with Mr. Stillman as to the result of his experiment with the strip of blackened wood laid upon the collodion film. I have tried a similar experiment, and find the images of bright objects sharply cut off. Even with a film of four thicknesses of collodion and an exposure of ten minutes, I cannot detect the smallest encroachment. The minute brushes mentioned by me in my last week's letter only occasionally occur, and appear to be due to a circulation in the liquid film beneath the opaque object, probably caused by some chemical impurity, for I notice that the brushes only occur when the film beneath the opaque object is soiled.

It cannot be argued that because there is a difference in the amount of irradiation in two pictures taken by different processes (instruments, exposures, and other conditions being similar), that therefore the spreading action must take place within the film, for the plates prepared by the two processes may not be equally sensitive, and the pictures may really correspond to what, with the same process, would be different amounts of exposure. Or again, the relative rates at which faint and intense light imprint themselves in the two processes may differ. Want of sensitiveness to the action of faint light is, I imagine, the reason why irradiation is apparently decreased by the use of the red collodion. A. COWPER RANYARD

Vapourising Metals by Electricity

IN a paper in NATURE (vol. x. p. 190) Mr. H. Hopkins gave a short description of some experiments on vapourising metals by electricity between two microscopic slides, and said that the layer thus produced can be investigated by a microscope, and employed in various ways to determine the character of the metal.

But the author did not point out the *wonderful drawings* shown by the layer, chiefly when a slight gold sheet is used.

This fact, very interesting in connection with molecular vibrations, has been illustrated by Prof. Magrini in a lecture delivered at the Museum of Florence, some years ago, and translated in *La Revue Scientifique* (t. iv. p. 770), with some woodcuts prepared by Prof. Magrini himself.

A. RODIER

Earth-shrinkings and Terrestrial Magnetism

IN my previous letter (vol. ix. p. 201) I gave some reasons for believing that the earth is shrinking chiefly about its equatorial region, and is being thrust out in the direction of the Poles, and that the distribution of this force may be correlated with that of terrestrial magnetism. As this view is somewhat novel and revolutionary, and if true will lead to considerable modification of the theories generally held on cosmical forces, I wish to support it by some other considerations.

I must predicate, as to a great extent proved, that volcanoes are not found in areas of upheaval. On this point I think the evidence is conclusive, and as I have previously written about it I shall not again enlarge upon it. I must predicate also that the earth as a whole is shrinking. This I tried to show in my previous letter. It follows from these facts that the large areas we know to be rising must be compensated by larger areas that are sinking, and that we may in a measure map these latter areas out by mapping out volcanoes; for, *ex hypothesi*, they occur either in areas of depression or along the border lines of the oscillating land.

Thus occurring, and themselves with the related phenomena of earthquakes, being the most vigorous proofs we have of the mobility of the earth's crust, we may predicate further that they will be found most actively at work where movements of the earth are most vigorously active, and that where they are liberally scattered, there the earth's crust is the most yielding. Now if we examine the distribution of volcanoes from this point of view we shall find that our main position is amply supported. Within the Arctic circle there is only one volcano, so far as we know—that of Jan Mayen. Within the Antarctic there is not one. North of the 60th degree of north latitude we have the volcanoes of Iceland, and three or four in Alaska, and these only. South of the 60th degree of south latitude we have Mount Erebus and its companions in the South Shetlands, and these only. Between the parallels of 40 and 60 the number of volcanoes increases considerably. In the northern hemisphere they probably number over sixty; but the vast majority of these are contained in the semicircular line of volcanoes formed by the Kurile and Aleutian Islands, and which crown that vast area of depression, the Pacific Ocean. In the southern hemisphere we still have exceedingly few, perhaps not more than a dozen, and these along the line of the Andes. It is in the region bounded on the north and south by the 40th parallels of latitude that we find volcanoes distributed in the greatest profusion, and the focus of distribution is even more narrow than this, for it may be bounded in fact by the 20th parallel on each side of the Equator. It is here we have that region described by so many writers in graphic terms, the Eastern Archipelago, with its 109 volcanoes in active operation. "From Papua to Sumatra, every large island," says M. Reclus, "including probably the almost unknown tracts of Borneo, is pierced with one or more volcanic outlets. There are Timor, Flores, Sumbawa, Lombok, Bali, and Java, which last has no less than 45 volcanoes, 28 of which are in a state of activity, and lastly the beautiful island of Sumatra. Then to the east of Borneo, Ceram, Amboyna, Golola, (the volcano of Ternata, sung by Camoens, Celebes, Mundanao, Mendora, and Luzon; these form across the sea, as it were, two great tracks of fire." (Reclus, "The Earth," 498.) Here also is that wonderful congeries of Pacific volcanoes described by the same graphic author. "The volcanoes of Abrim and Tanna, in the New Hebrides, Turahoro, in the Archipelago of Santa Cruz, and Semoya in the Salomon Islands, succeeding one after the other, connect the knot of the Feejees to the region of the Sunda Islands, where the earth is so often agitated by violent shocks. This region may be considered as the great focus of the lava-streams of our planet." It is within the same narrow limits also that we have the most active signs of movement in the Atlantic basin, namely, in the Little Antilles group of the West India Islands. In regard to the two regions last mentioned, there is a fact remarkably confirming the general position I argued in favour of in a previous letter, namely, that volcanoes are indicative of areas of depression, and which was unknown to me when I wrote it. M. Reclus says—"It is a remarkable fact that the two volcanic groups of the Antilles and the Sunda Islands are situated exactly at the Antipodes one of the other, and *also in vicinity of the two poles of flattening, the existence of which on the surface of the globe has been proved by the recent calculations of astronomers.* (Op. cit., p. 503.)

These facts seem to me to support very strongly my contention that the earth is shrinking chiefly in its equatorial region. Volcanoes are in my view the mediate and not the immediate results of the shrinking of the earth; earthquakes on the contrary are its immediate result. There is considerable difficulty in mapping out a chart of their frequency and intensity, but we may say safely that such a chart would have a deeply-coloured zone in the equatorial regions, that it is there where earthquakes and especially submarine earthquakes chiefly abound, and abound also in their more vigorous type. This can only be if that area is also the chief area of disturbance of the earth's crust. Another fact which points in the same direction is that discussed by Bischof, namely, that the soundings in the greater oceans increase as we near the equator, this increase taking place relatively to the land masses and not being merely due to the bulging out of the water in those parts by the force of attraction. So that if we accept the level of Africa or the Pampas of Brazil as a mean we shall find the greatest pits and hollows in the crust in the equatorial region.

In regard to the connection of this earth-shrinking with terrestrial magnetism, I wish to quote one or two paragraphs from Dr. Zollner's paper in the "Philosophical Magazine" on the origin of the earth's magnetism, to the conclusions of which, however, I cannot in any way assent. I quote him on the subject of the correlation of earthquakes with magnetic disturbances. He is quoting from Mr. Lamont's work.

"Kreil has given many cases," he says," where magnetic disturbances coincided with earthquakes; hence he thinks—cornection between the two phenomena probable. I have observed myself an extremely curious case in this respect on April 18, 1842; at 9.10 A.M., I saw by chance that the needle of the declination instrument received a sudden jerk so that the scale was pushed out of the field of view of the telescope. The oscillations continued for some time; at last the ordinary tranquillity was restored. After some days I received the news from Colla, in Parma, that he had observed violent oscillations of the needle, and comparisons showed that the movement had begun at the same moment in Parma as in Munich. A short time after, the report of a French engineer was published, on a violent earthquake which he had observed in Greece; and now it was found that the earthquake had taken place in the same minute in which the oscillations of the needle had been observed in Parma and Munich. This, together with the many cases collected by Kreil and Colla, leaves scarcely any doubt as to the presence of a close connection; but it is undecided whether one phenomenon is the consequence of the other, or whether they both come from the same source. The same connection between earthquakes and magnetic disturbances was observed by Lamont at the earthquake which took place in Greece in December 1861. He communicates his observations to *Poggendorff's Annalen* (vol. cxv. 176) in the following words: "As the connection of the magnetism of the earth with earthquakes still belongs to the insufficiently ascertained relatives, it will not appear irrelevant if I communicate a fact bearing upon this question. On December 26, 1861, at 8 o'clock A.M., when I took down the position of the magnetical instruments (some of which are put up in the magnetical observatory, viz. two for declination, two for intensity, and two for dip), I observed in all the instruments an uncommon restlessness, consisting in a quick and irregular decrease and increase in the declination, and at the same time a trembling in the vertical direction. The trembling of the needle only lasted for a short time, but the quick changes lasted until 8.30 o'clock with gradually increasing violence. Some days later the news was received of an earthquake which, exactly coincident with the above observations, had caused great destruction in many parts of Greece." (Philosophical Magazine, June 1872.) This goes far to show that terrestrial magnetism it to be correlated with the force which is shrinking the earth. HENRY H. HOWORTH

COLLIERY EXPLOSIONS

IT is astonishing that, notwithstanding the many generations during which coal-mining has been carried on in this country, so comparatively little has been done to investigate scientifically the causes of explosions in coal-mines, and thereby discover an antidote to a constantly recurring danger, one which adds considerably to the yearly bills of mortality, and still more to the number of widows and orphans. No doubt a considerable proportion of these sad accidents is owing to the carelessness of miners themselves, but very many are, without doubt, also due to ignorance, on the part of all concerned, of the conditions under which coal-mining must be carried on. Only the other day a melancholy tale of death and widespread mourning comes from Wigan—fifteen men killed, leaving behind them at least thirty-one persons destitute of the means of gaining a livelihood. We are afraid that the frequency of such accidents has made the public somewhat callous in the matter; but a little consideration must show the vast importance of acquiring a thorough knowledge of the conditions under which they may happen. To this end the paper recently read before the Royal Society by Mr. William Galloway, Inspector of Mines, is an important contribution; and we hope that the author and others who are competent will continue their investigations until, if explosions cannot be prevented, they may at least be foreseen and provided against.

The opinions promulgated by Sir Humphry Davy and the eminent Colliery Viewers who were his contemporaries, regarding the security afforded by the use of the safety-lamp, have been accepted with hesitation by many of their successors during the last twenty or thirty years; and this is not to be wondered at when we consider the large number of disastrous explosions by which thousands of lives have been lost in mines in which these lamps were in constant use. The illustrious inventor himself had discovered and pointed out, that if the lamp were exposed to the action of an explosive current, the flame might pass through the meshes of the wire-gauze and so originate an explosion; but when in good order it was considered to be safe under all other circumstances, until the experiments were made which form the subject of Mr. Galloway's paper.

At first, and for many years after the introduction of the safety-lamp, the cause of nearly every explosion was attributed to carelessness on the part of the workmen using it; then it was observed that a quantity of firedamp, sufficient to render some of the air-currents explosive, was sometimes suddenly given off by the strata, and these "outbursts of gas," as they are called, were assumed, in the absence of any other explanation, to have caused many explosions. On Dec. 12, 1866, however, the great explosion took place at the Oaks Colliery; as it was known to have happened simultaneously with the firing of a heavily-charged shot in pure air attention was drawn to the coincidence; and it appears that some search has usually been made for evidence of recent shot-firing in mines in which explosions have occurred since that date. Accordingly we find from the reports of the Inspectors of Mines that shot-firing was carried on in seventeen out of twenty-two collieries, at which important explosions have happened since Dec. 12, 1866; safety-lamps were certainly used in twelve of these collieries, and probably in the whole seventeen; in eight cases it was ascertained that a shot had blown out the tamping at or about the time of the explosion; in two an empty shot-hole was found from which it was supposed the tamping had been blown; in three a shot had been fired, bringing down the coal or rock; lastly, there were five collieries at which two or more explosions took place simultaneously, in different parts of the mine unconnected by a train of explosive gas. The Seaham explosion was a remarkable one; a heavily charged shot was fired in pure air in one of the in-take air-courses, and, according to the statement of three men who survived, the explosion of firedamp followed the shot immediately.

Two methods of accounting for the simultaneousness of the explosion of firedamp with the firing of the shot have been suggested in the reports of the Inspectors of Mines: one of them supposes that the firedamp has been ignited directly by the shot; the other that the concussion of the air caused by the explosion of gunpowder dislodges gas from cavities in the roof and from grooves, and that this gas passing along in the air-currents is ignited at the lamps of the workmen. In some instances when it has been known to be highly improbable that any gas existed nearer to the shot-hole than 10, 20, or even 40 ft., the advocates of the former hypothesis have taken it for granted that the gases issuing from the shot-hole were projected through the air as far as the accumulation of firedamp, retaining a sufficiently high temperature to ignite it on their arrival. On the other hand the advocates of the latter hypothesis have not attempted to show how the gas, which they assumed could be dislodged in quantity by a sound-wave and its reflections, could be ignited in those cases in which safety-lamps only were used. It is no doubt highly probable, however, that when once an explosion of firedamp has been initiated in one way or another, and large bodies of air are driven through the passages of a mine with great velocity, explosive accumulations will be dislodged from cavities and grooves and pressed through the safety-lamps with the velocity requisite to pass the flame.

In the beginning of the year 1872 Mr. Galloway first thought it probable that a sound-wave originated by a blown-out shot, in passing through a safety-lamp burning in an explosive mixture, would carry the flame through the meshes of the wire-gauze in virtue of the vibration of the molecules of the explosive gas. An explosion which took place at Cethin Colliery in 1865 is a good example of one that may have been caused in this way. Several days after the explosion the safety-lamp of the overman was found securely locked and uninjured, lying at a distance of a few yards within an abandoned stall which was known to have contained firedamp. Shot-firing was carried on in this mine, and it is not improbable that a sound-wave from an overcharged or blown-out shot had passed through this lamp and ignited the explosive mixture shortly after the overman had entered it; moreover, the Inspector of Mines in his report says he has no doubt that the gas in this state was ignited and was therefore the origin of the explosion, but he is unable to state by what means it was fired.

A number of experiments were made by Mr. Galloway in connection with this subject; the cost of apparatus, &c., was provided for by the liberality of the Government Grant Committee of the Royal Society.

The first experiment was made on Jan. 16, 1872, in the physical laboratory of University College, London. A sheet of wire-gauze 1 ft. square was inclined at an angle of 70° and a slow current of gas and air from a Bunsen-burner was directed against its lower surface; part of the explosive mixture passed through the meshes, and when ignited produced a flat flame 3 in. long by 1 in. wide about the middle of the upper surface of the wire-gauze. A glass tube 3 ft. 4 in. long by about 3½ in. diameter was placed horizontally with one end opposite to the flame on the same side of the wire-gauze and distant from it about 1½ in. At the other end of this tube a sound-wave was produced by the explosion of a mixture of coal-gas and oxygen contained in soap-bubbles. When the sound-wave passed through the tube the flame was carried through the meshes of the wire-gauze and ignited the gas issuing from the Bunsen-burner on the other side.

Some experiments similar to the first were made in one of the laboratories of the Royal College of Chemistry in Dec. 1872. The glass tube was replaced by a tin-plate tube about 20 ft. long by 2 in. diameter: paper and other diaphragms were inserted at a distance of 10 ft. from the origin of disturbance to insure that only a sound-wave was propagated through the tube. The results were the same as before.

Two sets of apparatus, a larger and a smaller, were then constructed; in both the sound-wave of a pistol-shot is conveyed through tin-plate tubes to a distance of about 20 ft., then it passes through a safety-lamp burning in an explosive mixture. In the smaller apparatus the tube is 3 in. in diameter; one end is closed by a disc of wood with a hole in the middle large enough to receive the muzzle of a pistol; at a distance of 10 ft. from the disc there is a diaphragm of sheet india-rubber, and at the farther end is a safety-lamp with gas-flame. At the bottom of the safety-lamp there is a circular chamber with holes round about from which gas can be made to escape, and when this gas, rising up, mixes with the air it forms an explosive mixture surrounding the wire-gauze cylinder. The pistol by means of which the sound-wave is produced is charged with ·205 gramme of gunpowder, and a tamping paper is rammed down well upon the charge. When the shot is fired through the hole in the wooden disc, while the explosive mixture surrounds the lighted safety-lamp, the flame is instantly carried through the meshes by the vibration, and ignites the gas on the outside. In the larger apparatus the tube is 8 in. in diameter, and 21 ft. long; at one end there is a wooden disc as before; at 20 ft. from the disc there is a sheet india-rubber diaphragm, and the extreme end is closed by a sheet of thin paper tied over it. Part of the last 12 in. (thus isolated from the rest of the tube and from the exterior) is enlarged sufficiently to hold a safety-lamp, and it is provided with an inlet below for air or air and gas, and a chimney above for the sake of the products of combustion. A lighted Davy or Clanny lamp of ordinary construction having been placed in this space, gas is made to mix with the air which flows up through it in consequence of the draught caused by the lamp: the appearances presented by the flame are observed through a small glass window, and when they indicate that the air is explosive the shot is fired. The flame within the safety-lamp is passed through the meshes, explodes the mixture in the isolated space, blowing out the paper end, and, passing backwards through the inlet, ignites the gas where it first mixes with air. In this case the shot consists of ·41 gramme of gunpowder tamped as before.

The lamps that were tested in this apparatus are those known as the Davy, Clanny, Stephenson, Mueseler, and Eloin. The flame was easily passed through the Davy lamp, with rather more difficulty through the Clanny, and not at all through any of the others.

The first experiments with these two sets of apparatus were made in January and February 1873, at the Meteorological Office, where Mr. Scott most kindly provided accommodation: the experiment with the smaller apparatus was shown at the Royal Institution, by Mr. Spottiswoode, on the evening of Jan. 17; and afterwards at one of the Cantor Lectures of the Society of Arts, by the Rev. Arthur Rigg. The next experiments were made in No. 7 Pit, Barleith, near Glasgow, with firedamp from a blower, but the flame could not be passed through the safety-lamps on account of the impurity of the gas, which contained only 75·86 of light carburetted hydrogen. The last experiments were made in the C Pit of Hebburn Colliery, near Newcastle-on-Tyne, also with firedamp from a blower, and as the firedamp was very explosive, the flame was easily passed through the Davy-lamps of each apparatus.

After this, experiments were made on a larger scale in part of a new sewer in North Woodside Road, Glasgow. The sewer is ovoid in section; it is 6 ft. high and 4 ft. wide at its greatest dimensions; part of it is a tunnel in the solid rock, part is built in brickwork through surface-drift. The gas safety-lamp of the smaller apparatus was placed on a board fixed across the sewer at a height of 2 ft. 8 in. from the bottom, and surrounded with an explosive mixture of coal-gas and air in the same way as when it was used in connection with the tin-plate tubes. Shots were fired from a pistol at certain distances from the lamp (the details of the distances and the charges required to pass the flame in the paper and sections of the sewer are given in the plates which accompany it). One hundred and nine feet was the greatest distance available in the part built of brick, and at this point a sound-wave of sufficient intensity to pass the flame was produced by firing a charge of 3·882 grammes = 59 grains of gunpowder. At 96 ft. from the lamp a charge of 3·276 grammes was required when the sound-wave passed through the brickwork tunnel all the way, and 2·184 grammes when it passed through the tunnel in the solid rock. These experiments seem to be perfectly conclusive.

Mr. Galloway's discovery—that when the vibration of the air which constitutes a sound-wave has a certain amplitude, it can transmit flame through the wire-gauze of the Davy and Clanny lamps—furnishes an additional argument against retaining these lamps in use, at least in the hands of ordinary workmen. On Dec. 15, 1815, Davy said he was convinced that, as far as ventilation was concerned, the resources of modern science had been fully employed; he then proceeded to describe a "safety lantern," which is identical in principle with the Stephenson lamp, and is *extinguished in* an explosive mixture (Phil. Trans. 1816, p. 2). This "safety lantern" was afterwards discarded in favour of the Davy lamp proper, the principal advantage of which was stated to be that it would not only preserve the collier from the firedamp, but enable him to apply it to use, and destroy it at the same time that it gave him a useful light (Phil. Trans. 1816, pp. 23 and 24). Fortunately the ventilation of mines is now better understood than it was in the days of Davy, and the quantities of air employed are usually very much greater. It is certain, however, that in some mines of the present day the ventilation could be doubled or trebled with advantage; and since this is merely a matter of expense it may be asked why it is not done, when it would ensure comparative immunity from danger? On the other hand it is now almost universally admitted to be highly dangerous to continue work in an explosive atmosphere, so that safety-lamps should be used only as a precaution against possible outbursts of gas or when work is carried on in the neighbourhood of gas that cannot be easily dislodged; it is evident, therefore, *primâ facie*, that lamps constructed on the principle of the "safety-lantern," such as the Stephenson, Müeseler, &c., which are extinguished in an explosive mixture, are far safer than lamps like the Davy or Clanny, which continue to burn under the same circumstances, and are then liable, at any instant, to have the flame driven through the wire gauze and communicated to the external explosive atmosphere.

THE COMET

[The following letter appeared in last Thursday's *Times*, from the columns of which journal it is reproduced, with a few verbal alterations.]

I WAS enabled on Sunday night (12th inst.), by Mr. Newall's kindness, to spend several hours in examining the beautiful comet which is now visiting us, by means of his monster telescope—a refractor of 25 in. aperture, which may safely be pronounced the finest telescope in the world, or, at all events, in the Old World.

The view of the comet which I obtained utterly exceeded my expectations, although I confess they were by no means moderate; and as some of the points suggested by the observations are, I think, new, and throw light upon many recorded facts, I beg a small portion of space in the *Times* to refer to them, as it is important that observers should have their attention called to them before the comet leaves us.

I will first deal with the telescopic view of the comet. Perhaps I can give the best idea of the appearance of the bright head in Mr. Newall's telescope, with a low power, by asking the reader to imagine a lady's fan opened out (160°) until each side is almost a prolongation of the other. An object resembling this is the first thing that strikes the eye, and the nucleus, marvellously small and definite, is situated a little to the left of the pin of the fan—not exactly, that is, at the point held in the hand. The nucleus is, of course, brighter than the fan.

Now, if this comet, outside the circular outline of the fan, offered indications of other similar concentric circular outlines, astronomers would have recognised in it a great similarity to Donati's beautiful comet of 1858 with its "concentric envelopes." But it does not do so. The envelopes are there undoubtedly, but, instead of being concentric, they are excentric, and this is the point to which I am anxious to draw attention, and, at the risk of being tedious, I must endeavour to give an idea of the appearance presented by these excentric envelopes. Still referring to the fan, imagine a circle to be struck from the left-hand corner with the right-hand corner as a centre, and make the arc a little longer than the arc of the fan. Do the same with the right-hand corner. Then with a gentle curve connect the end of each arc with a point in the arc of the fan half-way between the centre and the nearest corner. If these complicated operations have been properly performed the reader will have superadded to the fan two ear-like things, one on each side. Such "ears," as we may for convenience call them, are to be observed in the comet, and they at times are but little dimmer than the fan.

At first it looked as if these ears were the parts of the head furthest from the nucleus along the comet's axis, but careful scrutiny revealed, still in advance, a cloudy mass, the outer surface of which was regularly curved, convex side outwards, while the contour of the inner surface exactly fitted the outer outline of the ears and the intervening depression. This mass is at times so faint as to be invisible, but at other times it is brighter than all the other details of the comet which remain to be described, now that I have sketched the groundwork. These details consist of prolongations of all the curves I have referred to backwards into the tail.

Thus, behind the bright nucleus is a region of darkness (a black fan with its pin near the pin of the other pendant from it, and opened out 45° or 60° only will represent this), the left-hand boundary of which is a continuation of the lower curve of the right ear. The right-hand boundary is similarly a continuation of the lower curve of the left ear. Indeed, I may say generally—not to enter into too minute description in this place—that all the boundaries of the several different shells which show themselves, not in the head in front of the fan, but in the root of the tail behind the nucleus, are continuous in this way—the boundary of an interior shell on one side of the axis bends over in the head to form the boundary of an exterior shell on the other side of the axis.

At last, then, I have finished my poor and, I fear, tiresome description of the magnificent and truly wonderful sight presented to me as it was observed, on the whole, during some hours' close scrutiny under exceptional atmospheric conditions.

I next draw attention to the kind of change observed. To speak in the most general terms, any great change in one "ear" was counterbalanced by a change of an opposite character in the other; so that when one ear thinned or elongated, the other widened; when one was dim, the other was bright; when one was more "pricked" than usual, the other at times appeared to lie more along the curve of the fan and to form part of it. Another kind of change was in the fan itself, especially in the regularity of its curved outline and in the manner in which the straight sides of it were obliterated altogether by light, as it were, streaming down into the tail.

The only constant feature in the comet was the exquisitely soft darkness of the region extending for some little distance behind the nucleus. Further behind, where the envelopes of the tail were less marked, the delicate veil which was over even the darkest portion became less delicate, and all the features were merged into a mere luminous haze. Here all structure, if it existed, was non-recognisable, in striking contrast with the region round and immediately behind the fan.

Next it has to be borne in mind that the telescopic object is after all only a section, from which the true figure has to be built up, and it is when this is attempted that the unique character of this comet becomes apparent. There are no jets, there are no concentric envelopes; but, as I have said, in place of the latter, excentric envelopes indicated by the ears and their strange backward curvings, and possibly also by the fan itself.*

I prefer rather to lay the facts before observers than to state the conclusions to be derived from them, but I cannot help remarking that, supposing the comet to be a meteor-whirl, the greatest brilliancy is observable where the whirls cut or appear to cut each other; where we should have the greatest number of particles, of whatever nature they may be, in the line of sight; and not only so, but regions of greatest possible number of collisions associated with greatest luminosity.

---

* By describing three parabolas on a card and spinning the card rapidly round a line not coincident with their common axis, I have been able to reproduce roughly the appearances figured last week and described above.—J N L.

It would be a comfort if the comet, to partly untie a hard knot for us, would divide itself as Biela's did. Then, I think, the whirl idea would be considerably strengthened. I could not help contemplating the possibility of this when the meaning of the "ears" first forced itself upon my attention.

The spectroscopic observations which I attempted, after the telescopic scrutiny, brought into strong relief the littleness of the planet on which we dwell, for a seven hours' rail journey from London had sufficed to bring me to a latitude in which the twilight at midnight was strong enough to show the middle part of the spectrum of the sky, while to the naked eye the tail of the comet was not so long as I saw it in London a week ago.

I had already in observations in my own observatory, with my 6¼ in. refractor (an instrument smaller than one of Mr. Newall's four finders!) obtained indications that the blue rays were singularly deficient in the continuous spectrum of the nucleus of the comet, and in a communication to NATURE I had suggested that this fact would appear to indicate a low temperature.

This conclusion has been strengthened by Sunday night's observations, and it was the chief point to which I directed my attention. The reasoning on which such a conclusion is based is very simple. If a poker be heated, the hotter it gets the more do the more refrangible—*i.e.* the blue—rays make their appearance if its spectrum be examined. The red colour of a merely red-hot poker and the yellow colour of a candle-flame are due, the former to an entire, the latter to a partial, absence of the blue rays. The colour, both of the nucleus and of the head of the comet, as observed in the telescope, was a distinct orange yellow, and this, of course, lends confirmation to the view expressed above.

The fan also gave a continuous spectrum but little inferior in brilliancy to that of the nucleus itself; while over these, and even the dark space behind the nucleus, were to be seen the spectrum of bands which indicates the presence of a rare vapour of some kind, while the continuous spectrum of the nucleus and fan, less precise in its indications, may be referred either to the presence of denser vapour, or even of solid particles.

I found that the mixture of continuous band spectrum in different parts was very unequal, and further that the continuous spectrum changed its character and position. Over some regions it was limited almost to the region between the less refrangible bands.

It is more than possible, I think, that the cometary spectrum, therefore, is not so simple as it has been supposed to be, and that the evidence in favour of mixed vapours is not to be neglected. This, fortunately, is a question on which I think much light can be thrown by laboratory experiments.

J. NORMAN LOCKYER

Mr. Newall's Observatory, Ferndene, Gateshead

P.S.—(By Telegraph.)—Wednesday night.—Sunday's observations are confirmed. The cometary nucleus is now throwing off an ear-like fan. Ten minutes' exposure of a photographic plate gave no impression of the comet, while two minutes' gave results for the faintest of seven stars in the Great Bear.

*THE FORMS OF COMETS**

I.

A FEW years ago astronomers studied comets almost solely to determine their movements. So little advance had been made in the study of the figures of these bodies, that M. Arago believed himself justified in stating in his "Astronomie populaire:"—"'I don't know' will still be the reply we have to make to questions asked concerning the tails of comets." If I venture to take as the principal subject of this lecture the researches which I have undertaken during recent years in this difficult subject, I hope to disarm criticism beforehand by at once declaring that the results contrast singularly, by their imperfection, with the degree of power and of certainty we admire in the other more ancient branches of astronomy.

The reason of this contrast is very simple. While planetary astronomy received the precious heritage of the science of the Greeks and the treasury of observations bequeathed by the highest antiquity, cometary astronomy finds in the archives of history observations travestied by superstitious terror. One of the strongest prejudices of previous centuries was that which attributed to the stars a mysterious influence on our destinies. And comets, by their unforeseen appearance in the midst of the familiar constellations, their monstrous heads, their gigantic tails, were calculated to inspire a sort of apprehension which judicial astrology, that long infirmity of the human mind, did not fail to interpret as menacing presages; and as catastrophes have not been wanting in every period of our history, the singular sophism, *post hoc, ergo propter hoc*, so natural to our poor logic, helped to confirm ten or twelve times in a century this miserable superstition.

Did a comet appear in the heavens, morning or evening, the astrologer had to be consulted. He did not go to work without rules; he had a complete classification of strange forms under which these heavenly bodies already had been observed, and to each form was attached a particular signification. Pliny has preserved this nomenclature for us: Hevelius, the learned *pensionnaire* of Louis XIV., faithfully reproduced it in the middle of the 17th century, in the fantastic figures of his *Cometographia*. And, certainly, everything was taken in the most literal manner: in a comet with a crooked, or straight, or multiple tail they traced, such is the power of imagination, a gigantic sabre, a lance, or a fiery bolt, a burning torch or a dragon hurling upon an entire country the plague, rebellion or famine. Figs. 1 and 2 are indications of this idea taken from the "Theatricum cometicum" of Lubienitzki. The first comet, in the form of a blazing torch, indicates very clearly by the direction of its tail the flames which will consume the neighbouring town; the second, a veritable dragon, whose tortuous folds the artist has reproduced, threatens France and Ireland from the seven points of its tongue of fire.

These specimens will suffice; there is no use in producing similar statements and similar pictures; at the most we can barely find here and there in the theories which were then formed some traces of the truth.

Astrology thus stifled real observation until the beginning of the seventeenth century. This may now appear strange to us, but there is no doubt of it. The astronomers of those times, so near in time to ourselves, and already so bold with the universal *renaissance* of the human mind, were almost all to some extent astrologers. Kepler himself, one of the glorious fathers of modern astronomy, was obliged by the duties of his office as Imperial Astronomer both to draw the horoscope of the war of the Pope against Venice, and to give to his powerful but too-straitened patron, the Emperor Rodolph II., an opinion on the comet of 1607, which appeared to be menacing Hungary. Besides, Rodolph counted much then upon his alchemist to find the gold necessary to pay his army; while his general, the Duke of Friedland, the celebrated Wallenstein, never failed to consult the heavens, always by the help of Kepler, who has preserved for us his horoscope.

But already, from the time of Tycho Brahé, astronomy had commenced to place a hesitating foot in the domain of comets, from which she was soon to drive astrology. Until then men had lived, upon the faith of

---

* A lecture by M. Faye delivered at the "Soirées Scientifiques de la Sorbonne." Translated from *La Revue Scientifique*.

Aristotle, in the thought that comets were not celestial bodies, but mere sublunary meteors; and now it was discovered, by substituting observation for the word of the master, that they journeyed far above the orbits of Mercury and Venus, without being in the least incommoded by the crystalline spheres of the firmament in which the old astronomy incrusted its planets and stars. From the time of Newton comets were at last embraced, so far as the movement of the nucleus was concerned, in the theory of attraction, and consequently in planetary astronomy, with this single difference, that they described around the sun ellipses enormously elongated, almost parabolic, instead of ellipses almost circular, like the planets. Then astronomers observed carefully the successive positions of these nuclei, and calculated their orbits, but without attending to the figure of the comets themselves, although the invention of the telescope must have already revealed a number of curious phenomena which escaped the naked eye. During this period astronomers restricted themselves to representing the comet by a small circle, the centre of which alone was of importance, for there was the centre of gravity to which the laws of Kepler applied, and the calculation of the elements of the orbit. As to the tail, which attracted no attention, they figured it very simply by some feathery traces attached to the nucleus. In all this there is nothing to attract attention now, any more than the dragons of the astrologers. It was no longer now a superstitious prejudice which took from astronomers the desire to closely examine the facts; it was a preconceived idea, an elevated idea, no doubt, but too absolute, according to which the only force to be regarded in the celestial spaces was attraction. At bottom it was vaguely felt that the figures of comets were irreconcilable with this ruling hypothesis; and this was sufficient, for the eye was brought to bear by preference upon the subject the most attainable by the reigning theories.

FIG. 1.

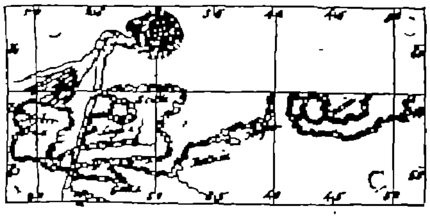


FIG. 2.

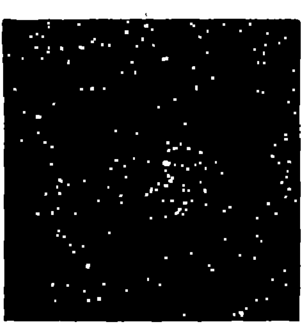


FIG. 3.

Leaving aside the rude drawings of the six-tailed comet of 1744, by Chézeaux, and those which Messier made by rule and compass, we must come down to the two Herschels before we find trustworthy observations on the form of comets; the beautiful drawings of the comets of 1811 and 1835 are even now of use to science. Astronomers had at last learned, from the example of Olbers and Bessel, the high importance of these phenomena, which reveal to us more than a new world, since they tell us of a new force in the universe. At present the figure of comets has become the subject of the most earnest research, and the drawings of the beautiful comet of Donati (1858) which I am about to show you will give you an idea of the change which, in this respect, has taken place in the minds of astronomers. I can confidently vouch for their fidelity, for, while Bond was executing these drawings at the Cambridge (U.S.) Observatory, by means of a telescope of great power, I followed the same body at Paris with the first telescope which Foucault constructed on his new system, and it appears to me while looking with you on these drawings of Bond, as if I still had that wonderful comet before my eyes.

I shall endeavour first to give an exact idea of the successive metamorphoses which comets present during the course of their appearance, taking as a type a comet which has been perfectly studied—that of Donati. Let us remember that these bodies describe around the sun ellipses extremely elongated, of which the sun occupies the focus; that the point nearest the sun is called the *perihelion*, while the most distant point (in a truly parabolic orbit this would be infinite) is called the *aphelion*. Unlike the planets, which describe orbits almost circular, and remain always at nearly the same distance from the sun, comets, in general, come to us from regions much more distant than the most remote planets; but they only become visible, even to the telescope, in the part of their orbit which is nearest to the sun. After their passage at perihelion, their distance from the sun becomes greater and greater, and soon they cease to be visible. I do not believe that any comet has been seen beyond the orbit of Jupiter. It is assuredly not on account of their smallness that they thus escape our notice in regions where the most distant planets, Saturn, Uranus, and Neptune, shine so clearly with the light which they borrow from the sun; this is because the rare and nebulous matter of comets reflect much less light than the solid and compact surface of the planets of which we speak, much less even than the smallest cloud of our atmosphere.

When they are seen far from the sun through a telescope, they appear like rounded nebulosities, but vaguely defined, presenting at the centre a condensation sufficiently marked, which is called the *nucleus*; it is this nucleus, more brilliant than any other part, whose position astronomers observe. Fig. 3, representing Donati's comet at the time of its discovery, June 5, 1858, gives a sufficient idea of the aspects of all comets when they are at a great distance from the sun.

At a later period, when the comet is approaching its perihelion, it sensibly lengthens out in the direction of the radius vector, *i.e.* in the direction of an imaginary line which would join the comet and the sun; but then the bright nucleus is no longer found in the centre of the figure, but is situated excentrically on the side nearest to the sun, as is shown in Fig. 4.

Later still, the tail is formed, and is developed more and more, like an opened fan, while the nucleus shines with a more vivid brightness. The comet becomes visible to the naked eye as in Fig. 5.

This tail is always away from the sun. At its origin, near the nucleus, it lies in the prolongation of the radius vector; at a greater distance it is curved backwards, as if it met with some resistance which hindered it from following completely the path of the nucleus. The bent axis of this tail is, however, always situated in the plane of the orbit, and this simple fact accounts for the many varieties of aspect presented to our eyes by these cometary appendages. Comets with straight tails appear such only because the eye of the observer is in the plane of the axis of the tail, *i.e.* in the plane of the orbit. When the earth, in consequence of its annual motion, is carried from this plane, the curvature of the tail becomes manifest; it becomes more and more pronounced as the comet, seen at first edgeways, so to speak, shows itself more and more on the flat, like a scimitar, to the observer.

When the comet, describing the descending branch of its orbit, reaches perihelion, these phenomena acquire their full development. But when it recedes from the sun, describing the ascending branch of its immense parabolic trajectory, the tail diminishes, disappears, and gives place to a mere elongation. Soon it again assumes the spherical form; the nucleus, which has gradually lost its brightness, is indicated only by a slight condensation of light at the centre of a globular mass entirely similar to that which was first seen. Finally this rounded nebulosity disappears.

Upon what scale do these phenomena take place, the immediate cause of which is evidently located in the sun? What may be the dimensions of these nebulosities, of these brilliant nuclei, of these curved tails? These dimensions are assuredly formidable. The comet of 1843 had a tail of 60,000,000 leagues, nearly double our distance from the sun. On the sky that tail was drawn like an immense dash of a brush of 65 degrees of angular amplitude. The tail of the famous comet of 1811 was only 40,000,000 leagues: but, on the other hand, the head alone of the comet (250,000 leagues in diameter) was nearly as large as the sun.

As to Donati's comet, its dimensions were more modest; its nucleus was 1,000 leagues in diameter, and the head only about 13,000; the tail was only about 14,000,000 leagues in length. I had the curiosity to estimate approximately the volume of this small comet, and I found, supposing that the thickness of the tail is equal to its breadth, its volume was a thousand times greater than that of the sun. As in reality the tails are flattened, it will perhaps be necessary to reduce this figure by half. There remains enough to show us that our terrestrial globe, so little beside the sun, is only a point in comparison with these gigantic bodies.

But, on the other hand, everything proves to us that these bodies contain very little matter in so enormous a volume. A characteristic which is special to them, and which assuredly belongs neither to the planets nor to their satellites, is their almost absolute transparency. The stars are seen through the tail of a comet as if the tail did not exist; they can be seen even through the head, much more dense and more brilliant than the tail. It was for long a question whether the nucleus, at least, of a comet would not be opaque and solid like a planet; but, after examination by the most powerful telescopes, it has always been found to be formed of nebulous layers, more and more dense, always permeable by rays of light. This very simple and altogether characteristic fact leads us, by itself, to think that cometary matter must be of extreme rarity, for a mist of some thousands or even of some hundreds of metres in thickness suffices to hide the stars, while a thickness of from 10,000 to 15,000 leagues of cometary matter scarcely lessens their lustre. Desiring to fix our ideas on this subject, I calculated the mass of Donati's comet, and found that it equalled at least that of a sea of 100 metres in depth, and 16,000 square leagues of superficies. This mass is only a fraction, almost imperceptible, of that of the earth. It was almost entirely concentrated in the head of the comet and around in the nucleus; even supposing it uniformly distributed over the whole volume of the tail, there will be found, for the mean density of that appendage, only a value incomparably more feeble than the density of the void approached by our pneumatic machines. But it is not to this rare gaseous residue that we must compare the matter of comets; it will resemble rather those impalpable grains of dust which dance in the air, and which are disclosed to us by the smallest ray of solar light penetrating a darkened chamber.

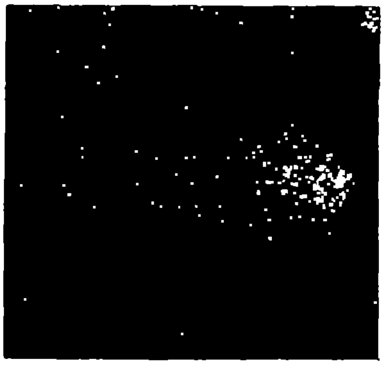


FIG. 4.

Although comets show us matter rarefied to such an extent that a celebrated physicist, M. Babinet, could with considerable justness call them "visible nothings" (*riens visibles*), do not, however, imagine that their contact with our earth would be without inconvenience. If the nucleus of our comet had directly encountered the earth, with its mass of 25,600 millions of millions of kilogrammes, and its relative speed of seventeen leagues per second (seven for the earth and ten in an opposite direction, for this retrograde comet), the actual energy of the shock would be enormous; I calculated that its transformation into heat would immediately generate fifty-one million *calories* per square metre of the hemisphere which sustained the shock. It would be enough to shatter, dissolve, and volatilise a part of the solid crust of our globe. No living being could survive such a catastrophe. Happily the probability of such an encounter is excessively small; and, indeed, the most remote geological ages do not bear any traces of such an adventure. We cannot, however, forget that meteors and shooting stars, perhaps even the aerolites which bombard us so regularly every year and every day of the year, have probably the same origin as comets, and result from a mass of analogous materials which are decomposed in penetrating our solar world.

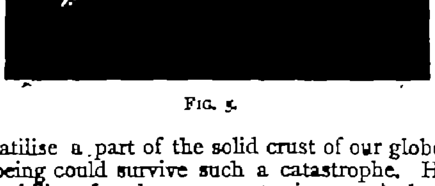


FIG. 5.

(*To be continued.*)

THE FLYING MAN

THE fatal experiment made by M. de Groof at Cremorne Gardens could not possibly have led to success. The possibility of directing an apparatus in the air by any mechanical contrivance, without actually using the lifting power of gas, is out of the question, and we do not wish to enter into a discussion on that point. But several interesting problems may be examined *à propos* of the inquest held by the coroner on the death of the unfortunate man.

De Groof's wings, irrespective of their motive power, may be regarded as two imperfect parachutes intended to diminish his rate of falling, and, if kept horizontal, prevent it increasing above a certain rate. It remains to see if their surface was large enough to keep that velocity within reasonable limits. The wings of De Groof were 30 ft. by 4 ft.; but being irregularly shaped, we may suppose the surface of each was 100 sq. ft., or in round numbers 200 sq. ft. for the two. The weight of the machine not being far from 4 cwt. if we include the man, we may say in gross numbers that each square foot had a kilogramme to support, which is more than ordinary; the parachute maker taking 1 kilogramme for each square metre, which is about ten times smaller.

But to ascertain if the velocity, although being larger than under ordinary circumstances, was really dangerous we must go to the formulæ established by General Didion and quoted by Poucelet—

$$R = 1·936\,(A\,0·036 + 0·084\,v^2)$$

Under the above circumstances, R the rate of falling is always inferior to the value of x given by the equation

$$10 = 1·936\,(0·036 + 0·084\,x^2)$$

x being obviously enough the velocity for which $R =$ to the weight pressing on the unit of surface. When the motion is such the velocity cannot be increased. If we make the calculation it is easy to see that the velocity is about 7 metres per second, almost = the fall from 3 metres to the ground. It is large, but not too large for a practised jumper, if he were clever enough to keep his balance, which is not very easy, it must be confessed.

Experiments on parachutes show that great oscillations always take place if the experimenters have not placed a small hole in the centre of their parachute, which increases stability at the expense of resistance. The motion of the wings, if they are working together, would very likely render the same service to the occupant of the machine, as they prevent the accumulation of the air. Unfortunately, to keep them working evenly is a difficult matter, requiring not only force of muscle but great presence and firmness of mind. The so-called *queue* or rudder was a useless encumbrance. A man working hard with his two hands, fighting for his life, cannot be expected to attend to direction with his legs attached to a rudder. The lifting power of the wings must have been very small indeed, although diminishing in some respects the rate of falling; but it is not easy to understand how a calculation may be made of the amount of mechanical power exerted in each stroke. The question must be left open for future examination.

W. DE FONVIELLE

NOTES

A CIRCULAR has been issued by the Hon. Local-Secretaries of the Belfast meeting of the British Association, calling attention to the numerous objects of interest, natural and mechanical, with which the town and neighbourhood of Belfast, as well as the county of Antrim, abounds. The whole Province of Ulster is full of objects of the highest interest to the admirer of natural scenery, to the geologist, the naturalist, and the antiquarian; and many of its most interesting localities, such as the Antrim Coast, the Giant's Causeway, the Mourne Mountains, Lough Neagh, the Round Towers of Antrim and Drumbo, are within an easy distance of Belfast. The local secretaries state that a large number of the hotels will be open to members of the Association at the usual charges, and that a list of persons willing to let rooms has been prepared. We sincerely hope that this time there will be no complaint to make on the score of accommodation. Conveyance to Belfast can be obtained from any part of the country at very reasonable rates.

THE Right Hon. Lord O'Hagan will preside over the Section for Economic Science at the meeting of the British Association.

A MEETING of the General Council of the Yorkshire College of Science was held at Leeds on the 17th inst. The Council proceeded to the election of the Professor of Geology and Mining, and the Professor of Physics and Mathematics. The vote of the Council was unanimously given to Mr. A. H. Green, M.A., late Senior Fellow of Gonville and Caius College, Cambridge, as Professor of Geology; and Mr. A. W. Rucker, M.A., Fellow of Brasenose College, Oxford, as Professor of Physics and Mathematics. Prof. Green for the last five years has held the appointment of Lecturer on Geology at the School of Military Engineering at Chatham. Prof. Rucker in Oct. 1871 was appointed Demonstrator in the Physical Laboratory of Oxford University under Prof. Clifton. The appointment of the Professor of Chemistry will be made on Friday. The Council recorded a cordial vote of thanks to Sir A. Fairbairn for his liberal offer of 2,000*l*., provided that the sum of 60,000*l*. was placed in the hands of the treasurer, and resolved to take the necessary steps for raising the required amount.

AT King's College, London, the Chair of Zoology and Comparative Anatomy, vacated by the resignation of Prof. T. Rymer Jones, F.R.S., has been filled by the election of Mr. A. H. Garrod, Fellow of St. John's College, Cambridge, and Prosector to the Zoological Society. The Chair of Materia Medica and Therapeutics, vacated by the resignation of Prof. A. B. Garrod, M.D., F.R.S., has been filled by the election of Dr. E. B. Baxter, Medical Tutor to the College.

THE prospectus has just been issued of a company to establish an aquarium for London, close to Westminster Abbey.

A BALLOON experiment to test a steering apparatus is soon to be made under the auspices of the authorities at Woolwich.

NORTHUMBERLAND, in Pennsylvania, on the Susquehannah, the place where Dr. Priestley was buried, has been selected by Americans as the spot at which all chemists are invited to gather on August 1 next, the hundredth anniversary of the discovery of oxygen by the illustrious philosopher. An address is to be delivered over his grave. This proposition of Dr. Bolton has met with a cordial response from a large number of chemists. Prof. Henry, of the Smithsonian Institution, proposes to be present with some of the original apparatus of Priestley from the Smithsonian collections. August 1 falling on Saturday, the meeting will be called for the day previous. A programme will be soon issued by the committee in charge.

THE Governing Body of Christ Church, Oxford, have voted the sum of 100*l*. per annum for five years in aid of the Biological Department of the Museum.

THE New Falcons' Aviary in the northern part of the Zoological Society's Gardens beyond the canal has just been completed, and is now tenanted by a fine series of the Diurnal Birds of Prey, principally exotic. Amongst them are examples of several rare species, such as the Red-backed Buzzard (*Buteo erythronotus*), the Laughing Eagle (*Herpetotheres cachinnans*), and the Malayan Crested Eagle (*Spizaetus caligatus*). Amongst the less-known European species are a pair of Bonelli's Eagles, a pair of Red-footed Falcons, and an Eleonora Falcon.

M. DOURNEAU DUPRÉ, a French explorer of the Sahara, has been killed by marauders on the way from Ghadames to Rhat. French colonists are making great progress in opening through the desert a road to Senegal by Timbuctoo and Niger; but Algerian refugees are their most determined opponents. The prospect of introducing water from the Mediterranean into the Chott has created a sensation in the colony and is very likely to lead to new efforts in desert exploration.

M. DE LESSEPS' scheme for making an inland sea in Algeria seems to have excited great alarm in some of the French journals. It is feared that the resulting evaporation will have a bad effect on the climate of France, one journal going so far as to suggest a return of the glacial epoch!

WE have just received the first two parts of a new monograph on the *Trochilidæ* or Humming Birds, by M. E. Mulsant, the well-known coleopterist, and the late M. E. Verreaux.

THE second series of the superb work "On the Butterflies of North America," by Mr. William H. Edwards, has just been commenced with the appearance of Part I. and with the promise of even greater beauty and excellence than the one recently closed. The illustrations, as in the preceding series, were drawn by Miss Mary Peart, who has made a specialty of this branch of art, and coloured at the establishment of Mrs. Bowen, of Philadelphia. The work bears the imprint of Hurd and Houghton, New York.

WE understand that Lieut. Cameron's journal, giving an account of his journey from Unyanyembe to Ujiji, has arrived in this country. He passed over a new route, to the south of that traversed by Capt. Burton, and north of Stanley's; and has thrown much light on the geography of the southern half of the Malagarazi drainage area. He has obtained several latitudes, and took a series of hypsometrical observations; but his most important work has been the final settling of the questions respecting the height of lake Tanganyika above the sea; and the latitude and longitude of Ujiji. Lieut. Cameron has recovered, at Ujiji, a most important map drawn by Dr. Livingstone, of the unknown country between Mikindany and Lake Nyassa, without which the record of the great explorer's discoveries would be very incomplete. Lieut. Cameron found the country between Unyanyembe and Ujiji in a more dangerous and unsettled state than ever. Mirambo and an independent body of runaway slaves were in complete possession of the route; and, though they would not molest an English officer, no Arab caravan or body of negroes could have passed. The insurgents attack and drive back all such parties, and the people would destroy all their food rather than give it to them. Lieut. Cameron's labours, first in his gallant attempts to succour Livingstone, then in furnishing aid to the explorer's servants, who brought down his body and effects, and finally in pressing onwards, in the face of great dangers and privations, to recover the journal and map at Ujiji, are deserving of the admiration of his countrymen. He is now on the verge of new discoveries, and resolved to achieve them; and we trust there will be a liberal response to the appeal for funds. Subscriptions to the Cameron Expedition Fund are received by Messrs. Ransom and Co., 1, Pall Mall East.

IN a paper in Petermann's *Mittheilungen* (Heft vii. 1874) by Dr. Joseph Chavanne, of Vienna, on "The Arctic Continent and Polar Sea," the author deduces the following conclusions from the data furnished by recent expeditions, and which he carefully discusses:—1. The long axis of the arctic land-mass (which probably consists of an island archipelago separated by narrow arms of the sea, perhaps only fjords) crosses the mathematical pole; it thus bends round Greenland, north of Shannon Island, not towards the north-west, but runs across to 82° or 83° N. lat. in a northerly direction, proceeding thence towards N.N.E. or N.E. 2. The coast of this arctic continent is consequently to be found between 25° and 170° E. long. in a mean N. lat. of 84° and 85°, the west coast between 90° and 170° W. long. in a latitude from 86° to 80°. 3. Robeson Channel, which widens suddenly north of 82° 16′ N. lat., still widening, bends sharply in 84° N. lat. to the west; Smith Sound, therefore, is freely and continuously connected with Behring Strait. Grinnell Land is an island which probably extends to 95° W. long., south of which the Parry Islands fill up the sea west of Jones's Sound. 4. The sea between the coast of the arctic polar land and the north coast of America is traversed by an arm of the warm drift-current of the Kuro Siwo, which pierces Behring Strait, and thus at certain times and in certain places is free of ice, allowing the warm current to reach Smith Sound. 5. The Gulf Stream gliding between Bear Island and Novaya Zemlya to the north-east washes the north coast of the Asiatic continent, and is united east of the New Siberia Islands with the west arm of the drift current of the Kuro Siwo. On the other hand, the arm of the Gulf Stream, which proceeds from the west coast of Spitzbergen to the North, dips, north of the Seven Islands, under the polar current, comes again to the surface in a higher latitude, and washes the coast of the arctic polar land, the climate of which, therefore, is under the influence of a temporarily open polar sea; hence both the formation of perpetual ice, as well as excessive extreme of cold, is manifestly impossible. 6. The mean elevation of the polar land above the sea diminishes towards the pole. 7. The sea between Spitzbergen and Novaya Zemlya to Behring Strait is even in winter sometimes free of ice, and may be navigated in summer and autumn. 8. The most likely routes to the pole are:—first, the sea between Spitzbergen and Novaya Zemlya; and second, the sea north of Behring Strait along the coast of the unknown polar land.

A NEW geological survey of the State of Pennsylvania has been ordered, and the bill providing for it has passed the Legislature and has received the signature of the Governor. Money for three years has been voted. Prof. J. P. Lesley, of the University of Pennsylvania, has been appointed Geologist-in-Chief.

THE programme of arrangements for the thirty-first annual meeting of the British Archæological Association is just out. The meeting will be held at Bristol in the week between Aug. 4 and 11, under the presidency of Mr. K. D. Hodgson, M.P. Excursions will be made to various places of interest in the surrounding district. Among the papers to be read at the evening meetings are the following:—On unpublished historical documents at Bristol, by W. de Gray Birch, Hon. Palæographer; and On the records of Merchant Adventurers, by Mr. J. de Haviland.

WE learn from the Report of the Radcliffe Observer that the number of transits observed from July 1, 1873, to July 1, 1874, is 3,093; and the number of zenith-distances, 4,191. The number of stars observed in the same interval is 1,585. Coggia's comet has been observed four times on the meridian and four times with the heliometer. With the heliometer, in addition to a small selected list of double stars which have been observed as usual, a series of ten measures of the equatorial and polar diameters of Jupiter has been made, and the diameter of Uranus has been measured several times. These observations have been made chiefly by Mr. Bellamy. The volume containing the results of observations for 1871 is complete and ready for distribution. This volume contains a catalogue of 1,331 stars:—97 observations of the sun, 51 observations of the moon, 25 of Mercury, 18 of Venus, and 14 of Mars; a catalogue of 21 double stars, of which several have been observed repeatedly; 11 measures of the equatorial and polar diameters of Mars, with the deduced apparent ellipticity, and diameter at mean distance; 8 occultations of stars by the moon, with the equations deduced from the occultations; and, finally, a considerable list of shooting-stars observed chiefly by Mr. Lucas. Considerable advance has also been made in the reductions for 1872-73.

WE would draw special attention to the Catalogue of the Anthropological Collection lent by Col. Lane Fox for exhibition in the Bethnal Green Museum. Only Parts I. and II. have been yet published, and these are almost entirely occupied with Weapons, which are divided into various classes, the lists under the various classes, or rather the contents of the various screens on which the specimens are arranged in the museum, forming the subjects of dissertations by Col. Lane Fox, who endeavours to trace out the probable origin and development of the various kinds of weapons. The principles which have guided Col. Lane Fox in making and arranging his valuable collection, he pointed out in his paper read at Bethnal Green on July 1, an abstract of which will be found in our last number, p. 217. He has abandoned the mere geographical arrangement, and adopted a principle as scientific, and we hope as productive, as that which obtains in natural history. A student of anthropology going carefully over Col. Lane Fox's collection at Bethnal Green, with this catalogue in his hands, would find himself both interested and instructed to a degree that it would be difficult to attain anywhere else.

WE rejoice to see from the tone of the replies to questions in the House of Commons on Monday by Mr. Disraeli and Lord Henry Lennox, that Government is conscious of how poorly housed some of our scientific collections are, and seems really disposed to take steps to remedy the evil. Mr. Disraeli said, in reply to a question concerning the Patent Museum, that it is not the only public institution which is suffering from want of space and of suitable accommodation. "That is now a crying grievance with respect to all our public buildings, collections, and offices. In regard to the Patent Museum, however, I am aware from a communication which I have received from my noble friend the First Commissioner of Works, that the matter is at present engaging attention." Lord Henry Lennox confirmed this by subsequently stating that he intended to propose to Her Majesty's Government a scheme which, if it were agreed to, would enable him to offer the Patent Museum suitable accommodation in the southern block of the International Exhibition buildings.

MR. JOHN MURRAY has in the press a memoir of Sir Roderick I. Murchison, based upon his journals and letters, with notices of his scientific contemporaries, and a sketch of the rise and progress, for half a century, of Palæozoic geology in Britain, by Prof. Archibald Geikie, LL.D., F.R.S., &c. It will be illustrated with portraits, and will be published in two octavo volumes.

MR. KARL TRÜBNER, of Strasburg, has recently published one part of a geological map of the neighbourhood of Heidelberg, the work of Drs. Benecke and Cohen. We especially draw attention to the fact that contour lines are given faintly marked in red. The other part, and the letter-press description, will not be ready till next year.

M. CAILLETET, in studying the compressibility of gases, has been led to investigate the resistance which glass tubes oppose to pressure. In one experiment a tube 21·7 in. long, and 0·7 in. diam., was crushed by an outside pressure of 77 atmospheres, while half that pressure sufficed to break it when exerted on the interior.

THE Geologists' Association has organised a lengthened excursion to the Cotteswold Hills, May Hill, and the Severn Valley, extending from Monday last, July 20, to Saturday, July 25. The head-quarters is at Cheltenham. Judging from the programme this excursion promises to be one of great interest; the directors are Dr. Thomas Wright, F.G.S., Mr. J. Logan Lobley, F.G.S., Mr. W. C. Lacy, F.G.S., and the Rev. W. S. Symonds, F.G.S.

THE first volume of the United States Commission of Fish (8vo, 899 pp., 38 plates and 3 maps) has been recently issued from Washington. In addition to reports of proceedings there are given arguments for and against protective laws, the natural history of some of the most important food-fishes; catalogue of marine algæ of southern New England; and papers on physical characters, invertebrate animals, &c., of different districts.

FOLLOWING the report of the Inspectors of Salmon Fisheries in England and Wales, that from the Inspectors in Ireland has just been issued, containing statistics concerning not only the salmon fisheries, but the deep-sea and coast fisheries as well. It is difficult, from the form of the report, to give any general idea of the condition of the salmon fisheries, but they appear to be slightly increasing in productiveness. The same complaints are made in Ireland as in England of the dangers from pollutions, and from the want of passes over the weirs. But the inspectors do not appear to have done anything to remedy either of these evils. The oyster fisheries are in a decaying state, and the beds licensed to private persons are almost unproductive; naturally better situated than England for the production of oysters, it seems a great pity that Ireland should not yield a large number of these molluscs, if proper care were only taken, and a little energy and capital expended in improving the beds. The herring fishery for the year was less than in 1872, while the mackerel fishery was nearly double; pilchards, however, are almost unutilised, though the mass of wealth in the waters is sufficient to make an industry that would rival that of the Cornish fisheries. If the inspectors could put a little energy into the matter and the people be made to see their opportunities, the fisheries of Ireland might be the richest in the world.

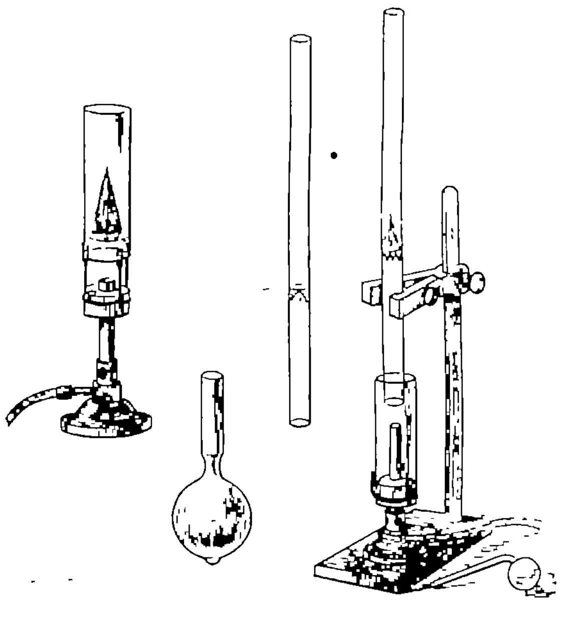
THERE appears a prospect of good coal being shortly made available for consumption in Japan. The largest of the coal-fields of Japan, that of Takosima, has come into possession of the Japanese Government, and it is hoped that an increased outlay of capital will produce satisfactory results.

THE *New Quarterly Magazine* for July contains, among other articles, an essay On birds and beasts in captivity, by Archibald Forbes, and an interesting paper by Mr. Evershed, On habit in plants and power of acclimatisation, in which, *àpropos* of the present state of the question of sewage farming, he remarks:—"It is a serious drawback to the profits of sewage cultivation that only certain plants are disposed to consume so much liquid as is offered to them under that system of management. Cereals are not drinkers to any large extent, and will not suddenly change their habits. They have enough to do to swallow the ordinary amount of wet which prevails in our climate, being naturally partial to rather drier countries like South Russia, Poland, and Spain."

THE additions to the Zoological Society's Gardens during the past week include three Giraffes (*Camelopardalis giraffa*) from Upper Nubia, purchased; two Passerine Owls (*Glaucidium passerinum*), European, presented by Mr. C. W. Tait; a Reeves' Muntjac (*Cervulus reevesi*), born in the Gardens; a Slow Loris (*Nycticebus tardigradus*), from the Malay region, deposited; a Coati (*Nasua nasica*), brown variety, and a Spotted Cavy (*Cœlogenys paca*) from South America, purchased; two Bronze-winged Pigeons (*Phaps chalcoptera*) and an Olive Weaver Bird (*Hyphantornis capensis*), hatched in the Gardens.

VIBRATIONS OF AIR PRODUCED BY HEAT

DURING the past session an interesting experiment was made by some students of the College of Physical Science, Newcastle-on-Tyne, engaged in their practical course of chemistry in the laboratory, sufficiently striking and remarkable to secure it, I have little doubt, a short notice among the records of a scientific journal. While testing the inflammable properties of the explosive mixture of air and coal-gas proceeding from the mouth of an unlighted Bunsen-burner, and observing its flame kindle and flashing back along a glass tube, it occurred to one of the students and to the chemical demonstrator, Mr. Haigh, to check the flame in its descent by inserting a piece of wire-gauze in the tube. On reaching the wire-gauze the flame rested there, as they expected; not silently, however, but bursting to their surprise with remarkable clearness and loudness into the peculiar singing strain of the chemical harmonicon. Mr. Haigh made several experiments on the flame with tubes of different sizes, which, if more immediate engagements had not prevented me from pursuing them, it had been my intention to have varied, and to have examined them more completely. In the form in which it first presented itself, a convenient and easily intelligible arrangement of which is here sketched, it appears, however, to offer all the attractions and the remarkable strength and variety of singing properties with which it seems to be abundantly endowed. A cylindrical lamp-glass mounted with a cork and wire-triangle on a Bunsen-burner serves to shield the mouth of the tube from draughts of air, and to preserve a steady flow of the entering gas. The tube is first lowered over this and lighted at the top; by raising it gradually sufficient air soon enters with the gas below to make the flame waver on the top of the tube, and finally descend to the wire-gauze, where it then burns most vociferously, especially if the wire-gauze is placed at the best position in the tube to produce some of its harmonic notes. The highest notes are sounded when it is above the middle, or even near the top of the tube, and the lowest when it is not far from the bottom of the tube; the stronger draught arising from the long column of heated air, which soon greatly assists the sound, appearing in the latter case to favour the production of notes of the deeper pitch. A glass tube about 2 ft. long and nearly 1 in. in diameter inside furnished a very powerful note, the wire-gauze being placed a short distance below the middle of the tube. By bending down the edges of a square or circular piece of wire-gauze over the flat end of a round ruler so as to fit the tube correctly, all passage of the flame between it and the tube is prevented, but when, as quickly happens with the increasing heat and updraught of the tube, the agitation of the flame grows more and more intense, it at length red-heats the wire-gauze, and passing through it lights the Bunsen-lamp below. A very instructive illustration is thus afforded of certain conditions in which the security of Davy-lamps in a fiery atmosphere can no longer be assured, where a sufficiently quick draught, or in this case the pressure of continued vibrations, carries the flame against the meshes of the wire-gauze until they are ignited. In one case danger arises of the wind carrying the flame of one side of the interior of the lamp over to the other side, which it red-heats; in the present case the vibrations carry the flame back upon itself. If in the former case a red-heated Davy-lamp is not turned round quickly to face the draught, explosion does not always follow; but in this case the current of explosive gas is immediately presented to the heated gauze, and not having undergone any previous combustion it is of course quickly kindled. On the other hand, another source of insecurity of safety lamps when exposed to sudden vibrations, or to the shock produced by a fall, is well shown, when it sometimes appears to happen, if the flame flutters very strongly, that it strikes through the wire-gauze without red-heating it, and lights the lamp below. This may, however, have occurred from imperfect fitting of the wire-gauze to the sides of the tube, and it would be interesting to repeat it if possible with precautions for making the surrounding junction quite secure. A lighted Davy-lamp suspended by a wire in a tin tube 3 ft. or 4 ft. long and wide enough to admit it easily, through which a stream of coal-gas mixed with air was passing made the tube hum very loudly, but no explosion followed, perhaps because it was not found possible to produce in the lamp a sufficiently violent agitation of the flame. A remarkable example of the ease with which the wire-gauze flame excites the notes of even very short, wide-mouthed tubes can easily be shown by inserting a well-fitting piece of wire-gauze 1 or 2 in. from the lower end of a straight lamp-glass, as shown in the sketch, and supporting this a few inches above an unlighted Bunsen jet. When the gas is lighted on the top of the wire-gauze and the heat of the glass chimney becomes sufficient to increase the draught, which may also be adjusted by varying the gas supply to the glass, its shrill treble note is sounded at once with overpowering loudness. The sensitiveness of the wire-gauze flame to acoustical impressions was, I believe, demonstrated very recently by Prof. Barrett, by many new and striking experiments on the depression of its luminous cap or top in obedience to the voice and to other sounds; and I have been assured both by Prof. Tait and by Prof. Marreco that the use of the smokeless wire-gauze burners, common in laboratories before the introduction of Bunsen's lamps, for exciting the hoarse music of singing flames in tubes of large calibre has long been familiar to them as a thoroughly effective means of reproducing the chemical harmonicon with common coal-gas. The easily inflammable nature of well aerated coal-gas combined with the conducting and quenching power of wire-gauze on flames which it supports, supplies an obvious explanation of the responsive vibrations of the flame to any description of rhythmical surrounding agitations and impulses. I was not, however, prepared for an equally remarkable and peculiar property of heated wire-gauze to the above, which, like the last experiment, was also shown to me by Mr. Haigh in some of his trials of the sounding tubes. When the flame had been sounding strongly and the gas was turned off to extinguish it, instead of ceasing immediately the musical note continued for a considerable time, sometimes even gaining a little in strength before it died away, the tube then appearing to have the power of intoning spontaneously without the presence of any visible exciting cause. That the source of these prolonged vibrations is the heat communicated to the wire-gauze, which enables it to expand the air by impulses in the tube as the ascending current gradually passes through its meshes was confirmed by a variety of experiments, all pointing to this origin of the sound as its real explanation. It happened on one occasion, when the flame passed through the gauze, lighting the Bunsen-lamp below, and leaving the gauze red-hot, that on putting out the lamp the after-note sounded so long and loudly as quite to equal, if it did not even surpass what had just been emitted by the flame. To reproduce the same note it is in fact only necessary to red-heat a wire-gauze diaphragm inserted a few inches above the lower end of a pretty wide glass tube over a Bunsen-flame, and to remove it from the lamp, when the gravest note of the tube will immediately be sounded *with all* the strength and purity that can be desired. Somewhat coarser wire gauze than that used for the singing-flame succeeds the best, as, besides being more easily red-heated by the Bunsen-flame, it furnishes a larger store of heat to the ascending air-current, which, in passing through its meshes, produces the singing sound. If the tube is raised quickly, the draught through it being thus checked it stops, and as soon as it is brought to rest



it begins to sing again; by lowering it quickly the note is much strengthened, as it is also by turning on an unlit gas-jet under it; and especially by swinging the tube round horizontally, the lower end foremost through the air, which increases the draught and the strength of the note most considerably. The note is silenced when the tube is held at rest inverted, or horizontally, but it begins again as soon as the tube is restored to its erect position. A closely twisted coil of thin platinum wire was compressed in the tube in the place of the wire gauze, and was made red-hot over the Bunsen-flame, which was then extinguished, and the gas again turned on immediately, causing the platinum wire to continue to glow by catalytic action. As long as its red-heat continued, the musical sound of the tube also continued to be produced. A glass tube 2 ft. long by 1¼ in. in diameter, stopped near one end with platinum wire-gauze, to the centre of which a small piece of spongy platinum is fastened, performs in this way over an unlighted gas-jet, when started by preparatorily heating the platinum gauze, for any length of time. Although unable to do so over ordinary coal-gas, yet it is very probable that over hydrogen (as a heat below redness is sufficient to maintain the sound) a tube thus fitted with pieces of platinum sponge laid upon wire-gauze would start and continue to sound by itself.

When a glass bulb is blown at the end of a glass tube it frequently happens that in cooling it emits a very clear and distinct humming sound. The note has appeared to me considerably graver than what would be expected from air vibrations in the small bulbs in which it occasionally occurs; thus in blowing the small candle-bomb, shown of its proper size on the left hand in the figure, a very loud note, of apparently about middle C pitch, or even lower, accompanied its cooling. In drying the glass bulb of a broken Wollaston's cryophorus, shown with its bent tube on the right in the sketch, by warming it very gently over a gas-flame to expel some adhering moisture, I was startled on removing it from the flame to hear the same humming note, although the bulb was scarcely hotter than could be touched with the hand, resembling in pitch (although its softness may have had a misleading effect upon the estimate) one of the lowest bass notes of an organ. Being familiar with the depth of tone obtainable with Helmholtz's spherical resonators, I am led to suppose that the combination of a bulb with a tube may have a much lower fundamental note than either of those cavities would have alone. But the acting source of the note requires also to be considered, and if, as appears evident, low beats and resultant tones cannot be reinforced without strengthening their primaries, the deep pitch of bulb-emitted notes may possibly arise from the nature of the air impulses by which they are produced. These appear to be of the same kind as the air-oscillations in the hot-gauze harmonicon. As the energy of the sound-waves cannot be produced without a corresponding motive cause, in the latter it is the ascending current of the rarefied, and in the former the in-draught of the contracting air, both produced by the dissipation or appropriation of a certain store of heat. The cold air entering the hot bulb or ascending through the heated wire meshes, expands in doing so, recoils upon itself, and throws the air column of which it forms a part into vibrations, which continue as long as the flow of air and heat together continue to support the motion. The rapid succession of explosions of the gas-flame harmonicon are, in fact, reproduced; the expansive force of the small puffs or explosions that produce the sound being merely derived from a limited stock of sensible heat, instead of from a constant supply of heat of combustion. Considering the volume and duration of the sound long after the wire-gauze has ceased to be visibly red-hot, the energy of the effect produced by the heated gauze seems to be out of all proportion to its magnitude; but the effects of the mechanical transformation of heat are, as is well known, always sufficiently startling, and sometimes even prodigious when the conditions under which it takes place are at all favourable to the process of the transformation.

I was not aware, when writing this description, that musical sounds produced by heating glass bulbs had been examined so long ago as the beginning of this century, as described in Prof. Tyndall's work on Sound, by the late G. De la Rive, who obtained them by boiling water in thermometer bulbs. The vapour in its passage along the tube is condensed, and by the collapse that accompanies its contraction throws the air column in the tube into vibration; this action is thus exactly the opposite of what occurs when fresh-blown strongly heated glass bulbs are allowed to cool, the expansion, instead of the contraction, then giving the necessary impulse. I am also disposed, since reading Prof. Tyndall's description and explanation, to ascribe the low note of the warmed cryophorous bulbs to the escape of aqueous vapour from it in the manner of De la Rive's experiment, rather than to the influx of cold air into the bulb to which I attributed it at first.

It is well known that at a nodal point of a vibrating air-column there is no oscillation, but alternate expansion and contraction of the air, while in the middle point of a vibrating segment the opposite is the case. Neither of these places is accordingly a suitable one for the combined air-pressures and oscillations to take place, which in a sounding flame or at a heated diaphragm can never occur separately or independently of each other, the strength of each little puff or explosion depending at once upon the direction and amount of the contributing oscillation; the position of the heating cause must accordingly be between the ventral and the nodal points. It is the same with the air-currents that excite the vibrations of a flute, railway whistle, common bird-call, or organ-pipe; the oscillations and throws of pressure of the air at the embouchures are not only simultaneous, but they must also be so related to each other that an inward oscillation accompanies increase of pressure, since a part of the blast is then thrown into the air-column and compresses it. From an easy law connecting together the changes of pressure with the motion of the air at any point of a stationary air-wave, it appears that in these instruments, exactly as in the hot-bulb, or in the hot-gauze and gas-flame harmonicon, the ventral point (as far as a true one exists) is not at the embouchures of the wind-instruments, nor at the heating and cooling points of the several kinds of heat-sirens or harmonicons, but outside of them in such a position as to place the exciting air-puffs between the nodal and the ventral point. Prof. Tyndall has truly pointed out in his sound lectures that whenever stationary undulations are kept up against friction, as when a stretched string is kept in uniform vibration by the hand, the nodal points are not absolutely stationary points, but present a little oscillation. It is equally true that the string does not remain accurately parallel to itself where it ought to show true ventral points, and accordingly resists a hand applied there to keep up its oscillations with a certain force; but this resistance is weak, and it acts through a wide excursion, while near the nodal points the necessary efforts of the hand are greater and exerted through very small displacements. In intermediate positions the nearer the string is held to a nodal point, and the smaller its excursions, the stronger must be the jerks given to it by the hand to keep up its oscillations. In air-instruments (including the harmonicon and flute) the jerks of the hand correspond to the explosive force of the small admitted puffs of air, depending in heat-harmonicons on the intensity of the heat or combustion, and also on the quantity of the matter burned or heated in the successive puffs; and in wind-instruments no doubt principally on the pressure and perhaps to some extent also on the quantity of the admitted blasts. According to the position of the embouchure (including a flame-jet or a heated gauze under the expression) in the vibrating segment of a wave of resonance, its beneficial action in maintaining the air-wave will be evoked or suspended in obedience to the particular conditions that exist in the air-wave at that point; the only absolute requirement for its activity being that entanglement of a fresh supply of blast must coincide with a moment of rising pressure at that point of the air-wave. This is easily accomplished in wind-instruments, the large excursions of the air at the embouchures ensuring a plentiful introduction of the entering wind-puffs at the proper time; the action in this case is quite free from complication, as without considering the small gains of pressure periodically given by the blast as it flows inwards, and a small suction that it exercises (to which I believe that Mr. Hermann Smith is the first to draw attention in his excellent communication on this subject in NATURE, vol. x. p. 161), as it retreats, nothing prevents the to-and-fro displacements at the mouth of an organ-pipe from so deflecting the current of the air-blast inwards and outwards as constantly to apply its useful energy to the best effect. Inward motion of air towards a node is accompanied by rising and outward motion by falling pressure, and as the losses of both of these kinds of energy are properly renewed by the blast in entering or retreating, the resonance of the wind-instrument is kept up. The friction and loss of energy in high harmonics is probably much greater than in graver notes, and, the air-excursions being also smaller, it is perhaps on this account that a stronger blast or a nicer direction of it by the mouth-piece is found necessary to produce and to maintain them. In heat-harmonicons the action is less simple, the alternations of pressure as well as the oscillations of the air determining the admission of the entering puffs. To judge from the position in which a singing-flame sounds best in a chemical harmonicon, a certain "lead" like that used in admitting steam to the cylinder of a steam-engine is necessary for the flames to exert their expansive force, the gas perhaps not instantly igniting on its emergence from the jet; and this "lead" the mere oscillations of the surrounding air are unable to supply; but in the position which the jet occupies in the tube, the air-pressures, which return at periods answering to a half stroke of the flame before the oscillations, precipitate its development and enable it to exert its pressures at the proper times. The proportion of lead given to the flame increases as it approaches the middle of the tube, where only the variations of pressure act upon it, while at the lower end of the tube it is commanded entirely, like the air-blast of an organ-pipe, by the oscillations of the air. It is perhaps thus that a wire-gauze flame burning at the foot of a lamp-glass sounds so vociferously, because *stationary* alternations of pressure in the lower part of the tube cannot affect the transmission of gas through the gauze, while the extensive oscillations there produced have perfectly free action in extinguishing and replenishing the flame. By using a piece of thin glass connecting-tube about 4 ft. long, held vertically over an unlighted Bunsen jet, on lighting the gas escaping at the top, and carefully raising the tube so as to allow the flame to descend very slowly, it may be made to pause in its descent at the successive ventral points corresponding to the harmonic divisions of the tube, sounding the note of the section of the tube above it as it comes to each point of rest. On lowering the tube it ascends, stopping and singing at some higher point of rest, depending apparently upon the less instantaneous inflammability of the gas. With some difficulty, and by shielding the lower end of the tube as much as possible from draughts, the flame was sometimes made to drop quickly within a few inches of the bottom of the tube, stopping always at the same place and sounding there for a moment the lowest note of the tube, when by the strength of its vibrations it was either rapidly extinguished, or else lighted the Bunsen lamp below. The notes sounded by these means were, however, not nearly so loud and effective as those obtained when the gas-flame was held at its stationary points by making it come to rest upon wire-gauze.

I am indebted for almost all of the foregoing experiments to Mr. Haigh, who was very skilful in suggesting and devising modifications of them, leading to the immediate conclusions regarding the mode of their production to which they appear most distinctly to conduct. Other occupations have hitherto prevented me from attempting to extend and to examine them as thoroughly as they seem to deserve; but the field of research presented by the study of harmonic flames does not yet appear to be nearly exhausted, and the repetition of the above experiments by others will perhaps throw more light upon the doubtful questions with which they are still to some extent surrounded, enabling, it may be, the many significant and easily-recognised features of singing flames to be produced with even more than their present ease and certainty.

A. S. HERSCHEL

SCIENTIFIC SERIALS

THE *Geological Magazine*, July.—In this number Mr. J. Croll commences an article On the physical cause of the submergence and emergence of land during the glacial epoch, which is to be continued. As far as it goes it is concerned with the conceptions we have of the thickness of continental ice. An attempt is made to estimate the thickness of the great antarctic ice-cap, about which "observation and experience to a great extent may be said to be a perfect blank." The condition of the interior of the antarctic continent is inferred from the little that we know of Greenland. The diameter of the ice-cap being taken at 2,800, the thickness at the centre is given at the lowest at 6 miles, reckoning a quarter of a degree *only* as the slope of the upper surface. Mr. Hopkins has recorded that he found one degree the least slope on which ice will move. An ice-cap of only 6 miles in thickness is to many an unfamiliar idea, and "few things," Mr. Croll writes, "have tended more to mislead geologists in the interpretation of glacial phenomena than inadequate conceptions regarding the magnitude of continental ice."—The other original articles are On the dawn and development of life on the earth, by H. Woodward, F.R.S.—Notes on carboniferous monomyaria, by R. Etheridge, jun.—The geology of the Nottingham district, by Rev. A. Irving.—There are two letters on the glaciation of the south-west of England, by Dr. Mackintosh and H. B. Woodward.—Mr. Mallet writes that he does not see how he can be charged with "misapprehending" Mr. Scrope in the discussion on the nature of volcanic heat, and asks that as he has reduced his own views to clear definition (Phil. Trans., vol. i. 1873) Mr. Scrope will do the same.

Bulletin de l'Académie Royale des Sciences, &c., de Belgique, No. 5.—M. Van Beneden contributes the first part (65 pp. in length) of a paper entitled "On the original distinction between the testicle and the ovary; the sexual character of the two primordial layers of the embryo; the morphological hermaphrodism of an entire 'individual'; an essay on the theory of fecundation." The "essay" opens with an introduction in which reference is made to Huxley's first pointing out that the organism of Zoophytes, Medusidæ, Polyps, Siphonophora and Hydroideæ consists essentially of two layers, endoderm and ectoderm, and also to other writers who have studied the relationships of endoderm and ectoderm in various aspects. The second part contains the history and bibliography of the subject, and the third (50 pp. long) describes the author's researches on *Hydractinia echinata*, made during a lengthened visit to Ostend. He first describes the characters which the male and female reproductive zooids have in common, and carefully details his methods of preparation. The microscopic description of the female and then of the male zooids or gonosomes is given in much detail, illustrated by plates. He arrives at the following conclusions:—The ovaries are developed entirely from the epithelial layer of the endoderm. Up to the time of maturity they remain entirely surrounded by the elements of the endoderm. The testicle and spermatozoa are developed from the ectoderm. The female sporosacs contain rudimentary testicular organs, and male sporosacs a rudimentary ovary. From a sexual point of view the ectoderm and endoderm have an opposite signification. If it is true that special organs have resulted from specialisation of function following division of labour, then we must believe that originally the whole ectoderm performed the male sexual function and the endoderm the female. The ectoderm is the animal and male layer, the endoderm the vegetation and female. Fecundation consists in the union of an egg, the product of the endoderm, with the product of the ectoderm, which brings chemical compounds of "opposite polarity" into union. The new individual is formed at the instant the elements of "opposite polarity" unite just as a molecule of water is formed by the union of atoms of hydrogen and an atom of oxygen.—M. Henry contributes papers on chloral and chlor-ethylic ethers, &c.—M. F. Plateau has sent in a communication on the digestion of insects, which is to be published in the memoirs.

Bulletin de la Société d'Anthropologie de Paris, t. vii.—In the seventh volume of this journal M. Hamy gives us the results of his examination of M. Janneau's officially conducted investigations into the anthropology of Cambodia. He begins by endeavouring to define the meaning attached to the three words, "Moi," "Kha," and "Penang," which have hitherto been used in Annamite, Laolian, and Kmer almost indiscriminately to indicate the wild tribes of the hills. By the first of these we must understand the negro tribes occupying the oriental chain of the Cambodian range; in the second a people not unlike the yellow races of Laos; and in the third the tribes in whom the flat-faced non-Caucasian type is strongly marked. The Cambodians themselves distinguish between races, known as Kuôi, who, they say, are the primitive people of the land but not savages, and the Rodê, the former being employed in the extraction of the ores of Kompong Svai, and the latter in the breeding and care of horses, while both are exempt from the yoke of slavery which presses heavily upon nearly all the other tribes. In the Cambodian language M. Janneau thinks he can trace evidence of identity with many of the primitive forms of the roots of the mother-tongue of the Indo-European languages. The Aryan name "Rama" appears among the ancient regal titles of Cambodia, and while the Sanscrit "Ramayana" includes the Cambodians amongst the offspring of the immaculate cow, *Cabala*, the people themselves have from the most remote antiquity made the cow the object of special adoration.—The question of the depopulation of certain districts, more especially in the Polynesian and other Australasian insular groups, has lately attracted especial attention among the members of the Anthropological Society of Paris. The Gambier Islands, which in

1838 had 2,000 inhabitants, had in 1872 only 650. M. Leborgne shows, however, that although alcoholism does not exist in these islands, where fevers and smallpox are unknown, rheumatic, neuralgic and nephritic affections are not uncommon, whilst phthisis and scrofulous degeneration are attended by a frightful mortality, which seems to point to the injurious results of consanguineous unions. M. Broca is disposed to attribute the gradual diminution of the Polynesian and other analogous peoples to the moral action of certain depressing influences to which savages are exposed when they find themselves brought suddenly in contact with civilised men. The very contact of civilisation seems to exert in and for itself a destructive action on their physical nature. M. de Quatrefages considers, in a separate paper, the same question in reference to the general diffusion amongst the Polynesian races of tuberculosis, which was not observed by the early discoverers, but has now attained such dimensions that its presence could scarcely escape the notice of the least observant travellers. In the universality of its destructive action on all the Australasian islands, M. de Quatrefages sees another and most incontrovertible evidence of the unity of the entire race.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, June 15.—In this number is commenced a review by Herr Fritsch of M. Poey's "New Classification of Clouds," published in the *Annales Hydrographiques*. After insisting on the importance to sailors, farmers, gardeners, and others, of a knowledge of clouds with a view to prediction, M. Poey has remarked how few observers have recorded the kind of cloud, the shape, rate of movement, course, and change of direction or shift, which differs with the height at which it floats. The ideas of men who have busied themselves with clouds, from Aristotle to Maury, are commented upon and criticised. Lamarck was the first to divide clouds into classes, and Howard's system, which followed independently a year later, differed but slightly in the main from that of the French naturalist. The stratus of Howard he regards as nothing but a fog, and the cumulo-stratus as a cumulus. His own fracto-cumulus resembles Lamarck's "attroupés," and his pallio-cirrus and pallio-cumulus, determined by observation in the Antilles, replace the nimbus of Howard. The sub-divisions of Admiral Fitzroy, based merely upon quantity, lead to error. As to the stratus, the first mistake arose from its being described as a mist by Howard himself, and the next from his followers raising the thin streak of fog to the dignity of a cloud. For Kamtz says of the cirro-stratus, that when seen at the zenith it appears to be made up of a number of cloudlets, but near the horizon like a long and very narrow streak. This cloud might therefore be confused with the stratus as represented, especially as both are common at sunrise and sunset. This error, namely, making the stratus anything but a fog, has been followed in all publications since 1815, including one of Kamtz in 1840, and the plates of Schubler, of the Smithsonian Institution, of Maury, and of the French Ministry of Marine (see NATURE, vol. ix. p. 163).

Reale Istituto Lombardo. Rendiconti: t. vii. fasc. vi., March.—The following papers are contained in this number:—In hydraulics there is a paper by M.E. Lombardini, On floods and on the inundation of the Po in 1872.—In experimental physics, Prof. Rinaldo Ferrini contributes a paper On the reversal of the current in Holtz's electric machine.—Prof. Alfonso Corradi contributes a paper to the history of medicine on certain unpublished writings of Morgagni.—Tome vii. fasc. vi., April, contains the following papers:—In the section of mathematical and natural science there is an anthropological paper by Prof. Cesare Lombroso, On tattooing amongst criminals in Italy.—In chemistry there is a note by Prof. Egidio Pollacci, On the action of sulphur on earthy carbonates, particularly on calcium carbonate as relating to geology and agriculture.—In mechanics, Prof. Giuseppe Bardelli contributes a mathematical note entitled "Researches on the moment of inertia."

Funfzigste Jahresbericht der Schlesischen Gesellschaft fur Vaterlandische Cultur (1872).—This Society has its head-quarters at Breslau, and, according to the present report, numbers 443 acting, 32 honorary, and 198 corresponding members. It is at present under the presidency of Dr. Goppert. The account of proceedings, now before us, attests considerable vigour and industry during the year. In the department of natural science, perhaps the most important paper is that of Prof. Cohn, giving the results of his observations on Bacteria, and their relation to putrefaction and contagion.—Dr. Roemer reports on some bone-remains of rhinoceros found in the Trachenberg; and Dr. Göppert traces the history of the elk in Silesia.—The family of the Cirratulides is described by Prof. Grube; and we also find accounts of a collection of Javan birds, and Transcaucasian insects in the Society's museum, and of plant-eating Cetacea.—Dr. Poleck discusses the experimental bases of the so-called modern chemistry.—Prof. Cohn's report in the botanical section is of considerable length. We may note in it Dr. Stenzel's paper, On the Riesengebirge as a limit of vegetation. He finds that about thirteen species of phanerogam and cryptogram vascular plants belong only to the Silesian side, and about as many only to the Bohemian side of the range. The entire number of plant species in that highland region is estimated at about 200, so that about an eighth finds its limit at the watershed of the range.—There is also an instructive paper by Prof. Göppert, On the relation of the plant-world to weather.—Dr. Schroter communicates a list of the fungi he has met with at Rastatt during a four years' residence; and Dr. Göppert reports on the fungus collection in the museum of the Botanical Garden in Breslau.—Descriptions of flora of the Grunberg and other localities in Silesia are furnished by various observers.—The Society has a section specially devoted to horticulture, and the report on this, presented by M. Muller, contains a good deal that will be found of value by the practical gardener.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, June 24.—John Evans, F.R.S., president, in the chair.—The following communications were read:—New Carboniferous Polyzoa, by Prof. John Young, and Mr. John Young, Hunterian Museum, Glasgow University (see NATURE, vol. ix., p. 456).—On *Palæocoryne* and other polyzoal appendages, by Prof. John Young and Mr. John Young, Hunterian Museum, Glasgow University.—The steppes of Siberia, by Thomas Belt. The author described the portion of the Siberian steppes traversed by him as consisting of sand and loam. The best section seen by him was at Pavlodar, where he found 1 ft. of surface-soil, 20 ft. of stratified reddish-brown sand, with lines of small gravel, 8 ft. of light-coloured sandy silt, 15 ft. of coarse sand, with lines of small pebbles and one line of large ones, and 6 ft. of clayey unlaminated silt, with fragments of the bed-rock in its lower half, the bed-rock being magnesian limestone much crushed at the top. The generally accepted marine origin of the great plain was said to be negatived by the absence of sea shells in its deposits, whilst *Cyrena fluminalis* occurs in them. The author regards them as deposits from a great expanse of fresh water kept back by a barrier of polar ice descending far towards the south. In its greatest extension this ice-barrier would produce the crushing of the bed-rock; and as it retreated, the water coming down from the higher ground in the south would cover a continually increasing surface.—On the microscopic structure and composition of British Carboniferous dolerites, by S. Allport.—Additional remarks on boulders, with a particular reference to a group of very large and far-travelled erratics in Llanarmon parish, Denbighshire, by D. Mackintosh.—Note on the Bingera diamond-fields, by Archibald Liversidge.—Remarks on the working of the molar teeth of the *Diprotodon*, by Gerard Krefft, F.L.S.; communicated by the president. In this paper the author criticised a figure of the lower molars of *Diprotodon*, published by Prof. Owen, on the ground that the teeth are represented in it in an unabraded state, and stated that when the last tooth breaks through the gum the first of the series is always worn flat. He also remarked on the peculiar modification of the premolar in the genus *Diprotodon*.—Descriptions of species of *Chætetes* from the lower Silurian rocks of North America, by Prof. H. Alleyne Nicholson, F.R.S.E. In this paper the author accepted the union of *Chætetes* and *Stenopora* made by Milne-Edwards and Haime, and stated that *Monticulipora* D'Orb. and *Nebulipora* McCoy, also seemed to him to belong to the same generic group, for which he proposed to employ the name *Chætetes*.—On the composition and structure of the bony palate of *Ctenodus*, by L. C. Miall; communicated by Prof. P. Martin Duncan, F.R.S.—Notes on a railway section of the Lower Lias and Rhætics between Stratford-on-Avon and Fenny Compton, and on the occurrence of the Rhætics near Kineton and the Insect-beds near Knowle in Warwickshire, and on the recent discovery of the Rhætics near Leicester, by the Rev. P. B. Brodie.—The resemblances of ichthyosaurian bones to the bones of other animals, by Harry Govier Seeley, F.L.S. In this paper the author endeavoured to give precision to the term ichthyosaurian by analysing the characters of the Ichthyosaurian skeleton into the resemblances which it presents to skeletons of other vertebrates. Ichthyosaurian characters are subdivided into Mammalian, Avian, Crocodilian, Chelonian, Lacertilian, Camelonian, Rhynchocephalian, Ophidian, Urodelan, Piscine, Plesiosaurian, Dinosaurian, Dicynodont, and Labyrinthodont. By thus classifying the characters it is anticipated that the affinities of the Ichthyosaurian type may be rendered evident.—The resemblances of Pleiosaurian bones with the bones of other animals, by Harry Govier Seeley, F.L.S. This paper is an attempt to make a similar analysis of the Plesiosaurian skeleton.—On the tibia of *Megalornis*, a large struthious bird from the London clay, by Harry Govier Seeley, F.L.S. The author considered that the skull named by Prof. Owen *Dasornis* might, if it belonged to a bird, be referred to *Megalornis*; but he detailed considerations which led him to suggest that *Dasornis* may possibly be a fish.—On cervical and dorsal vertebræ of *Crocodilus cantabrigiensis* Seeley, from the Cambridge Upper Greensand, by Harry Govier Seeley, F.L.S.—On the base of a large Lacertian skull from the Potton sands, by Harry Govier Seeley, F.L.S. This specimen was interpreted by the author as the anchylosed basioccipital and basisphenoid of a Dinosaur. The author did not regard the specimen as giving support to Prof. Huxley's hypothesis of the Avian affinities of Dinosaurs.—A section through the Devonian strata of West Somerset, by Harry Govier Seeley, F.L.S.—On the pectoral arch and fore limb of *Ophthalmosaurus*, by Harry Govier Seeley, F.L.S. After some remarks on the structure of the pectoral arch in *Ichthyosaurus* the author described parts of a skeleton discovered by Mr. Leeds in the Oxford clay, on which he founded the genus *Ophthalmosaurus*.—The glacial phenomena of the Eden Valley and the western part of the Yorkshire Dale district, by J. G. Goodchild; communicated by H. W. Bristow, F.R.S. This paper is a continuation, in a northward direction, of the investigation of glacial phenomena which formed the matter of a paper lately read before the Society by Mr. Tiddeman, and published in the Society's journal.—Geological observations made on a visit to the Chaderkul, Thian Shan range, by the late Dr. F. Stoliczka. In this paper the author gives an account of the geology of the district traversed by him in his journey from near Kashgar to Lake Chaderkul on the Russian frontier, a distance of about 112 miles, his route lying among the southern branches of the Thian Shan Range. Three principal ridges were crossed. The first, or "Artush ridge," consisted of newer Tertiary deposits of bedded clay and sand, mostly of a yellowish white colour. These "Artush beds" were traced by the author for a distance of 22 miles. The southern slopes of this range were covered with gravel from 10 to 15 ft. thick, which passes into a conglomerate with a thickness of about 200 ft. The second, or "Kokan range," is formed on the southern side of old sedimentary rocks, whilst the northern is occupied by newer Tertiary deposits and basaltic rocks, the former consisting of shales and limestones, in which the author found some fossils, inducing him to refer them to the Trias. These are succeeded by some dark-coloured shales, slates, and sandstones, dipping at a high angle to the north. On the denuded edges of these the new Tertiaries rest, consisting of sandstones interstratified with basaltic rocks. These latter increase in thickness till just beyond Kulja an old "somma" is reached, with perpendicular walls rising to a height of 1,500 ft. above the river. The cone of the volcano has disappeared by subsidence. The third ridge, "Terek-tagh," consists of old sedimentary rocks, chiefly limestones.—Note upon a recent discovery of tin-ore in Tasmania, by Charles Gould.—Note on the occurrence of a Labyrinthodont in the Yoredale rocks of Wensleydale, by L. C. Miall; communicated by Prof. Huxley, F.R.S. The author briefly describes a specimen, discovered by Mr. W. Horne, of Leyburn, in the Lower Carboniferous Rocks there, comprising casts of five bones. He considers that these bones belong to an animal of higher rank than any known fish, and thinks that the Lower Coal-measures of Glasgow, with *Loxomma*, may be of earlier date than the Yoredale Rocks.—Geological Notes on the route traversed by the Yarkund Embassy from Shahidulla to Yarkund and Kashgar, by Dr. F. Stoliczka. The author described the rocks observed by him along the course of the Karakash river and through the Sanju pass as chiefly metamorphic, and very highly inclined, until near Yâm sedimentary rocks rest unconformably on the schists. These are probably Palæozoic. Later rocks occur near the camp Kiwáz, some resembling the rocks of the Nahún group, and underlain by deposits containing Carboniferous fossils. At Sanju coarse grey calcareous sandstones and chloritic marls of Cretaceous age occur. True Loess occurs in some of the valleys.—The hematic deposits of Whitehaven and Furness, by J. D. Kendall.—Notes on the Physical Characters and Mineralogy of Newfoundland, by John Milne. Notes on the Sinaitic Peninsula and north-western Arabia, by John Milne.—Giants' Kettles at Christiania, by MM. W. C. Brögger and H. H. Reusch; communicated by Prof. Kjerulf. The authors first refer to the popular notices about giants' kettles, and describe in detail a number of these pits, which were examined and emptied near Christiania. They then mention the theory concerning their origin. From their own facts and reading they conclude that many of these remarkable pits were made at the bottom of "Moulins" during a glacial period, when the locality was covered with ice on the scale of existing ice in Greenland. The contents of these pits are traced to their parent rocks, which are higher up towards the great valley of Gulbransdal, in which glacial phenomena abound. They are inclined to conclude that moraine matter was washed off the glacier-ice from time to time, and left in the pits at last.

Geologists' Association, July 3.—Henry Woodward, F.R.S. president, in the chair.—On the deposits now forming in British seas, by G. A. Lebour, F.G.S. The author limited his present task to a brief description of the principal constituents of British sea-bottoms, with particular reference to their distribution and its causes. The materials are of mechanical, chemical, or organic origin.—*Rock-bottoms*. In some places no deposit occurs, the bare rock being left. The largest of these bare spots, in British seas, occurs in the western half of the Channel Valley. Their distribution is directly connected with that of currents, and this is strikingly proved by their being limited to no relative depth; for, in the Channel, their range extends entirely across the valley. Another bare area exists at the point where the Atlantic cable enters the yet deeper region of the Atlantic ooze in 500 fathoms water. The specimens brought up by the sounding instruments from such places consist of weathered and rotten stone, pointing to chemical rather than mechanical disintegration, even where powerful currents are present.—*Marine deposits*. These consist chiefly of sand, with occasional islands of clay, mud, gravel, and shell detritus. The broader the sea the greater the proportion of sand: thus the North Sea bottom is especially a sandy one, though towards the centre the sand becomes muddy over a considerable region. Sandy bottoms also largely prevail in the north-western seas and on the west coast of Ireland; but south of Ireland a large expanse of pure mud and muddy sand extends in a south-easterly direction.—*Organic deposits*. In the Channel the shell deposits attain their greatest development as regards British seas. There they form two long, occasionally broken lines, following at a short distance the English and French shores, and forming at the outer mouth of the Channel a vast shell bank. These deposits actually cross the broad sea-valley partly over and considerably to the west of the spread of bare rock previously mentioned. Beyond the ocean valley which lies between the Hebrides and the Rock-hall reef, there occurs a fish bank more than three miles in length, affording us an inkling of the manner in which some of our long-fossilised fish-beds may originally have been accumulated.—*Fluvio-marine deposits*. The Thames, Seine, and Tay form mud banks in a sandy sea. The submarine delta of the former has the shape of a triangle, of which the apex points seawards; that of the Seine is also triangular in outline, but the apex points landwards. Such submarine deltas can only be recognised when the materials of which they consist are distinct from those forming the prevailing sea-bottom. Although much of the above materials are at present incoherent, especially the sands, it is not probable that the larger features of the sea-bottoms are liable to important changes, whilst the surrounding geographical conditions remain unaltered. The same agencies, which sweep certain spots, have heaped-up material elsewhere, and the relative form of both covered and uncovered portions of the sea-floor is preserved by them. *The points of* the greatest violence of current action are shown by the bare rock patches, whilst the intermediate stages of agitation are represented by coarse shingle, sandy gravel, sand, and finally patches of mud or clay supervene, which, to a certain extent, indicate centres of calm.

Entomological Society, July 6.—Sir Sidney Smith

Saunders, president, in the chair.—Prof. Westwood exhibited specimens of *Haltica aurata*, which he had found to be very injurious to young rose-leaves. Also, a portion of a walnut attacked by a Lepidopterous larva, probably a Tortrix; but he was unable to name the species, as it produced only an ichneumon. It was the first instance he had known of a walnut being attacked by an insect in this country. Mr. F. Moore stated that he had on one occasion reared *Carpocapsa splendana* (a species that usually feeds on acorns) from a walnut.—Prof. Westwood made some remarks on the Yucca moth (*Pronuba yuccasella* Riley), of which some fifty specimens had been sent to him, in the pupa state, by Mr. Riley; but he had succeeded in rearing only three. He exhibited a drawing of a portion of the insect, showing the extraordinary form of the palpi, which was especially adapted for collecting the pollen, with which it impregnated the female flowers. He directed attention to a full description of the insect and its habits by Mr. Riley, in the sixth Annual Report of the Insects of Missouri.—Prof. Westwood also exhibited some bees which had been sent to him from Dublin, having been found attacking the hives of the honey-bees. They were smaller than the honey-bee, and black, and he considered them to be only a degenerated variety of *Apis mellifica*. He suggested the probability of their being identical with the "black bees" mentioned by Huber.—Mr. Champion exhibited *Amara alpina* and other beetles from Aviemore, Invernesshire.—The Secretary exhibited some specimens of a Dipterous insect which had been found in the larva state in an old Turkey carpet. The larva was very long, slender, and serpentiform; it was white and shining, and had something the appearance of a wire worm, but much longer, and without feet. The name of the insect was not ascertained.—Mr. Bond exhibited specimens of *Argas pipistrellæ* parasitic on a bat, and also some *Acari* from a small species of fly; both were from the Isle of Wight.—Mr. Boyd exhibited specimens of *Thecla rubi* from St. Leonard's Forest, differing in certain points from the ordinary type.—Mr. Wormald exhibited a collection of butterflies sent from Japan by Mr. H. S. Pryer.—Mr. W. Cole exhibited some galls of a species of *Cecidomyia*, found in West Wickham Wood.—Mr. F. Smith exhibited some earthen cocoons found on wet mud at Weymouth by Mr. Joshua Brown. They proved to belong to a Dipterous insect (*Machærium maritimum*), one of the *Dolichopidæ*.—Mr. S. Stevens exhibited specimens of *Asopia nemoralis* from Abbot's Wood, Lewes, and other Lepidopterous insects.—Mr. Butler exhibited a copy of a very rare (if not unique) book, which had recently come into the possession of Mr. E. W. Janson, entitled Lee's "Coloured Specimens to illustrate the Natural History of Butterflies" (London, 1806). He could not find that it had been quoted in any synonymic catalogue, and it contained coloured drawings and diagnoses of nineteen species of butterflies.—The Rev. H. S. Gorham read descriptions of species of Endomycid Coleoptera not comprised in his catalogue, "Endomycici recitati." Also, Some remarks on the genus *Helota* (*Nitidulidæ*), of which he described a new species from Japan.—Dr. Sharp communicated a supplementary paper On some additional Coleoptera from Japan.—Prof. Westwood communicated Descriptions of new species of *Cetoniidæ*, principally from the collection of Mr. Higgins.—The President announced that the library of the Society would remain for another year at 12, Bedford Row, and it was hoped that by that time some more permanent and suitable place would be obtained for it.—Part III. of the Transactions of the Society for 1874 were on the table.

PARIS

Academy of Sciences, July 13.—M. Bertrand in the chair.—The perpetual secretary announced the death of M. Angstrom, and the president made some remarks expressive of the regret of the Academy at the loss they had sustained. The following papers were read:—Observations relating to M. Tacchini's last note and to the recent memoir of M. Langley, by M. Faye. The author gave an extract from Langley's memoir, showing that this observer accepted, with certain restrictions, the cyclone theory of sun-spots.—On chemical actions other than metallic reductions produced in capillary spaces, by M. Becquerel. This is a continuation of the author's researches in electro-chemistry.—Observations on the subject of the establishment of an inland sea in Algeria, by M. de Lesseps.—Memoir on the chronological classification of geological formations, by A. E. B. de Chancourtois.—On some applications of Abel's theorem to curves of the second degree relative to the elliptic functions, by M. H. Léauté.—On the observation of a phenomenon analogous to that of the "*goutte noire*," by M. Devic.—Observations on the obstacles to be opposed to the attack of vines by Phylloxera, a letter from M. Bourgeois to M. Dumas. The writer made four propositions relating to (1) the direct destruction of the insects; (2) the preservation of isolated stocks; (3) the preservation of a field of vines not attacked; and (4) treatment of a field partially attacked. Several members made remarks on the same subject. M. Elie de Beaumont suggested the use of snow.—Note relating to the *viriel* of M. Clausius, by M. F. Lucas.—Note relating to the theory of osculatory surfaces, by Mr. Spottiswoode.—Remarks on the pyrheliometric observations of Pouillet, a reply to the criticisms of M. Faye, by M. Duponchel.—On chemical achromatism, by M. Prazmowski. This was a note descriptive of the construction of the photographic objective to be used by M. Janssen for photographing the solar disc.—Second note on the electric conductivity of ligneous bodies, by M. Th. du Moncel.—On indications furnished by conjugate thermometers *in vacuo*, by M. Marié-Davy.—Qualitative research on arsenic in organic and inorganic substances, by MM. Mayençon and Bergeret. The authors have devised a new plan for detecting arsenic (depending upon the action of arseniretted hydrogen on mercuric chloride), which possesses extreme delicacy.—Action of heat on the isomers of anthracene and their hydrides, by M. Ph. Barbier. The author has extended his investigations to the following substances:—the two ditolyls, ethylene and diphenyl mixed, and benzyltoluene. Fritzsche's phosene appears to have been a mixture of anthracene and phenanthrene.—New experiments on human locomotion, by M. Marey.—New experimental researches on inflammation and mode of production of leucocytes of pus, by M. J. Picot. Action of salts of biliary acids, by MM. V. Feltz and E. Ritter.—Observations on the first phases of development of *Pelobates fuscus*, by M. G. Moquin-Tandon. These phases are in the main identical with those of the common toad.—Analyses of the samples of wine exhibited at the exhibition of the Pavillon du Progrès, by M. Ch. Mène.—On globular lightning, by M. Gaultier de Claubry. This was a description of some of the effects of the thunderstorm which broke over Paris on Thursday the 9th inst.

BOOKS RECEIVED

AMERICAN.—Baird's Annual Record, 1873.—Proceedings of the Boston Society of Natural History, vol. xvi. part ii.—Field Ornithology, comprising a Manual of Instruction for procuring, preparing, and preserving Birds, and a Check List of North American Birds: Dr Elliott Coues, U.S.A. (Trübner).—The Birds of Florida, Part iii.: C. J. Maynard (Ipswich, U.S.A.).—Bulletin of the Buffalo Society of Natural Science (Warren & Co., Buffalo).—Circles of Deposition of American Sedimentary Rocks: J. S. Newberry.—Theory of Arches. Prof. W. Allan (Van Nostrand, N.Y.).—My Visit to the Sun; or, Critical Essays: Laurence S. Benson (J. S. Burton, N.Y.).—Annual Report of the Trustees of the Museum of Zoology, Harvard, Camb. U.S.A. for 1873.—Birds of Western and North-Western Mexico: G. A. Lawrence (Boston Natural History Society).—The Organisation and Progress of the Anderson School of Natural History (Welch, Bigelow & Co., Camb. U.S.A.).—Sea Fisheries of the South Coast of New England: Spencer and Baird (Washington).—The Vertebrate Animals of Vineyard Sound: A. E. Verrill and S. J. Smith (Washington).—First, Second, and Third Annual Reports of the United States Geological Survey of the Territories for 1867-69 (Washington).—Geological Survey of Ohio, vol. i. Palæontology (Columbus).—Reports of the Geological Survey of Missouri, 1855-71 (Jefferson City).—Reports of the Geological Survey of Missouri Iron Ores and Coalfields, 1872 (N.Y.).—Atlas to Geological Survey of Missouri (N.Y.)

CONTENTS

PAGE
THE PUBLIC SCHOOLS COMMISSION 219
THE SUB-WEALDEN EXPLORATION (*With Illustration*) 220
THE SCIENCE OF PAINTING. By ARTHUR SCHUSTER 221
OUR BOOK SHELF 222
LETTERS TO THE EDITOR:—
Photographic Irradiation.—J. AITKEN; A. C. RANYARD, F.R.A.S. 222
Vapourising Metals by Electricity.—A. RODGER 223
Earth-shrinkings and Terrestrial Magnetism.—H. H. HOWORTH, F.G.S. 223
COLLIERY EXPLOSIONS 224
THE COMET. By J. NORMAN LOCKYER, F.R.S. 226
THE FORMS OF COMETS (*With Illustrations*). By M. FAYE 227
THE FLYING MAN. By W. DE FONVIELLE 230
NOTES 230
VIBRATIONS OF AIR PRODUCED BY HEAT. By Prof. A. S. HERSCHEL (*With Illustration*) 233
SCIENTIFIC SERIALS 235
SOCIETIES AND ACADEMIES 236
BOOKS RECEIVED 238

THURSDAY, JULY 30, 1874

JOSEPH PRIESTLEY

DURING the present week the centenary of the birth of Modern Chemistry, as the discovery of oxygen on August 1, 1774, may justly be called, is being celebrated both in this country at Birmingham and Leeds, and in America at Northumberland, Pennsylvania; we have therefore thought it would be acceptable to our readers to be reminded of the principal events in the life of the author of this all-important discovery.

Joseph Priestley was born on March 13, 1733, at Fieldhead, near Leeds. At the age of six years he lost his mother, and his education was superintended by Mrs. Keighley, his aunt, a woman apparently of unusually wide sympathies. At an early age young Priestley distinguished himself at school by his great aptitude for learning languages; he was familiar with Chaldean, Syriac, and Arabic, and without the aid of a master acquired some knowledge of German, French, and Italian. A pupil of Maclaurin taught him mathematics. He took great interest in theological controversies, and his aunt's tastes provided him with many opportunities of gratifying his liking in this matter. Having studied for the Dissenting ministry, he was called to be minister of a small Unitarian congregation at Needham Market, in Suffolk, in 1755. Here he remained until 1758, when he went to occupy a similar post at Nantwich, in Cheshire. Here he opened a school, and by dint of rigid economy was able to buy some physical apparatus, with which he made, to his young pupils, a series of experiments that drew upon him the notice of the authorities of the Warrington Academy, so well known in connection with the name of Aikin. In 1761 he went to this Academy to take Dr. Aikin's place as teacher of languages and literature, and soon after married the daughter of a Welsh ironmaster. While at Warrington he published a number of works on various subjects, including the "Theory of Language and Universal Language" (1762-68), "Essay on a Course of Liberal Education for Civil and Active Life" (1765), "Chart of Biography" (1765), Chart of History" (1769), &c. A visit which he made to London during this period gave him the opportunity of forming a lasting friendship with Franklin and Price. He communicated to the former his intention of writing a history of discoveries in the department of electricity; and not only did he receive from Franklin a warm approval of the scheme, but also all the books and memoirs he required; and before the end of the year, by dint of persevering work, the first volume was published, under the title of "The History of Electricity" (London, 1764, 4to). Three editions of this were published by 1775; but it bears evident marks of having been written in haste.

Previous to the publication of this work, in 1766, Priestley was chosen a Fellow of the Royal Society, and about the same time the University of Edinburgh conferred upon him the honorary degree of LL.D. In the same year as the above-mentioned work was published, Priestley left Warrington and became pastor of Mill-hill Chapel, in Leeds. While here he was much occupied with theological controversies, but by no means neglected his scientific studies, as about 1768 his attention was drawn to chemistry, the result being that in 1772 he communicated to the Royal Society a paper entitled "Observations on different kinds of Air," for which the Copley Medal was awarded to him.

Meantime, Priestley had received an offer to accompany Capt. Cook on his second expedition to the South Seas; this he accepted gladly, but received an intimation that his nomination had not been confirmed by the Board of Longitude on account of his advanced theological opinions. In 1773, however, at the recommendation of his friend Price, he was appointed librarian to the Earl of Shelburne (afterwards Marquis of Lansdowne) at a comparatively liberal salary. In the following year, he accompanied this nobleman into France, Germany, and the Low Countries. At Paris his scientific reputation easily procured him the acquaintanceship of well-known men of science. Besides his salary, Lord Shelburne allowed him expenses for a laboratory, and it was on Aug. 1, 1774, that he made the discovery which marks so important an epoch in the progress of chemical science, and the centenary of which is being celebrated both in England and in America during the present week. The discovery was that of oxygen gas, which he announced in his "Experiments and Observations on Air," the first volume of which was published in 1774.

For some unexplained reason, Priestley and Lord Shelburne parted in 1780, the latter covenanting to allow the former till his death a pension of 150*l.* Priestley then settled in Birmingham, to which he was attracted, no doubt, by the prospect of meeting with men of kindred scientific tastes. Here he was chosen pastor of one of the principal Dissenting churches, his friends subscribing to defray the expenses of his scientific experiments and his theological controversies, for he was regarded as one of the greatest controversialists of his age. His opinions both on ecclesiastical and political topics were much ahead of his age; but this is not the place to enlarge on this aspect of the character of this remarkable man. We may only mention that he was brought forward as a candidate for the French National Convention, and was nominated a French citizen, a title of which he was very proud. For his unconcealed liberality and advanced opinions he was doomed, however, to suffer, as the populace of Birmingham, roused to a state of blind fury by the partisans of Government, rushed to Priestley's house, July 14, 1791, and set fire to it, reducing it and nearly all it contained to ashes. However, as the result of an examination, Priestley subsequently received an indemnity of 2,000*l.* for this mad act, this sum being considerably increased by the liberality of his private friends.

Although no word of complaint escaped Priestley concerning this misfortune, it no doubt influenced him to a considerable extent in deciding him to quit his native land for republican America. After spending three years in a college at Hackney, as Professor of Chemistry and minister, he embarked on April 7, 1794, and fixed his residence at Northumberland, in Pennsylvania. Even here it was some time before he was allowed to remain at peace, as a spiteful rumour had been circulated that he was a secret agent of the French Republic. Here he lost his wife and his youngest son, and here he himself died on Feb. 6, 1804.

Turning now from the external aspects of Priestley's life, let us consider the position he held as a philosopher and the influence that his discoveries had on the science of his time. The ever-memorable discovery of "dephlogisticated air" on Aug. 1, 1774, marks an epoch in the annals of chemistry with which the name of Dr. Joseph Priestley will be always associated. He obtained it by exposing a quantity of red precipitate of mercury to the action of the sun's rays concentrated upon it by a lens; the red precipitate was contained in a flask filled up with mercury and inserted in a basin containing the same metal. "I presently found," he says, "that by means of this lens air was expelled from it very readily. Having got several times as much as the bulk of my materials, I admitted water to it, and found that it was not imbibed by it; but what surprised me more than I can well express, was that a candle burned in this air with a remarkably vigorous flame, very much like that enlarged flame with which a candle burns in nitrous air exposed to iron or lead of sulphur; but, as I got nothing like this remarkable appearance from any kind of air besides this particular modification of nitrous air, and I knew no nitrous acid was used in the preparation of *mercurius calcinatus*, I was utterly at a loss how to account for it." He then goes on to show that red lead and nitre also afford oxygen at a red heat, and calls it, consistently with the theory of combustion which was then prevalent, *dephlogisticated air*, regarding it as common air deprived of phlogiston, and consequently possessed of a powerful affinity for that imaginary principle.

This discovery, however, though unquestionably brilliant, must not be allowed to eclipse those other numerous and valuable contributions to science with which this indefatigable worker enriched the stores of natural knowledge during a period ranging from 1768 to 1800. There are indeed few branches of natural science which did not reap some benefit, direct or indirect, from the discoveries of the experimenter whose memory we now recall.

On the 17th of August, 1771, Priestley enclosed a sprig of mint in air in which a taper had been allowed to burn out, and he found on the 27th of the month that the same air then permitted the combustion of another taper with perfect facility. Thus was the secret of vegetable respiration first made known. In the discoverer's own words: "This restoration of air I found depended upon the vegetating state of the plant; for though I kept a great number of the fresh leaves of mint in a small quantity of air in which candles had burned out, and changed them frequently for a long space of time, I could perceive no melioration in the state of the air." In pneumatic chemistry (of which the germs had been originated by Black, Mayow, Hooke, and Hales), Priestley found a new engine of research, and in his hands this ὄργανον yielded vast results. His productions in pure chemistry are too well known to be discussed fully here, even did space permit. In addition to oxygen he discovered nitrous oxide (1776), sulphurous anhydride (1774), ammonia gas (1774), carbonic oxide and hydrochloric acid gas (1772): he was also the first to investigate the properties of nitric oxide. We may point to nitrous oxide *en passant* as one of the many instances in which pure science has furnished a substance of practical utility to man: the discoverer of "dephlogisticated nitrous air" little dreamt that the lapse of a century would see this substance used as an anæsthetic for the purposes of dentistry. The pneumatic and mercurial troughs, now indispensable parts of our laboratory "plant," were also bequeathed to us by the philosopher of Fieldhead. Although chemistry received the greater part of Priestley's attention, other branches of science, as before stated, received the benefit of his thoughts. Thus we find a work by him bearing the date 1772, entitled "The History and Present State of Discoveries relating to Vision, Light, and Colours," and we have already referred to his "History of Electricity." From a catalogue of Priestley's works, printed at the end of his "Experiments and Observations relating to various branches of Natural Philosophy," we find that this extraordinary man was the author of no less than thirty-six volumes on various subjects; among others, the theory and practice of perspective, charts of history and biography, rudiments of grammar, observations on education, a course of lectures on oratory and criticism, an essay on the first principles of government, and on the nature of political, civil, and religious liberty, together with large numbers of works on metaphysical subjects and on theology.

But it is with the *chemical* aspect of Priestley's life that we are more particularly concerned at present. The anniversary about to be celebrated is that of a purely chemical discovery, and one which to us appears doubly important, first, from the great flood of light which it shed on the processes of combustion and of respiration, both animal and vegetable, aërial and aquatic; and secondly, from the powerful illustration which it affords of the value of a new method in scientific investigation. The purely practical results which in after years flowed from the discovery of oxygen, such, for example, as the oxy-hydrogen blowpipe, which enables large quantities of platinum and of the most refractory metals to be smelted with ease, are at present of minor interest. Is it not this over-anxious regard for "practical results" that has led to the complaints, too frequently made, about the decline of chemical research in England? The spirit of the old investigators of the school of Priestley, Cavendish, and Black seems to be forsaking us, and, with certain exceptions, our most efficient workers are devoting their time and energies to effecting permutations and combinations among the elements—in seeing in how many ways certain atoms of carbon, hydrogen, and oxygen can be combined, or in locating atoms to certain imaginary positions in space. It must not be for a moment supposed that we advocate the entire cessation of this kind of work—it is useful in its way as supplying facts, but by itself it is not sufficient to lead us to hope for any great advancement in our knowledge of chemical laws. The greatest advancements in chemistry have been the results of the application of *physical* discoveries—witness the vapour-density control for the formulæ of compounds and the atomic weights of the elementary gases; or the determination of specific heat as a means of controlling the atomic weight; or turn again to that great engine of modern research, the spectroscope, which has enabled us to extend our list of known elements, and which reduces the chemistry of this globe and of suns infinitely remote to one common basis. So also is isomorphism an essentially physical phenomenon and one for the explanation of which we shall doubtless be hereafter indebted to physics. The Newton of chemistry may be looked for in the ranks of physicists. In the meantime let us only hope for "new methods" of research—let investigators seek for some method bearing the same relation to our chemistry that the "pneumatic chemistry" of Priestley did to that of his time.

ON TESTIMONIALISM

JUST now, there must be several scientific men asking themselves what can be the conceivable value of testimonials in determining the relative fitness of a number of candidates for any appointment of such importance as a Professorship of a most important branch of natural science in a great seat of learning.

It is not a point of any great difficulty to determine, to one's mental satisfaction, in what cases testimonials are of value—for they are sometimes most useful—and when they are worthless in comparison to other methods for testing the relative efficiency of different men.

Testimonials, or an examination, or the two combined, are no doubt necessary, when the post to be competed for is one, the qualities required for which are not capable of being exhibited to an electoral body by the competitors in any other way. For minor appointments, therefore, such as clerkships, smaller educational posts and the like, they are indispensable; as they are in cases where the intimacy of the relationship between the holder of the post and those he is placed above is close. But for appointments so honourable and responsible as the Professorship of Physiology in the University of Edinburgh, or that of Chemistry in the University of Glasgow, we cannot help thinking that testimonials are a farce. Candidates for such chairs are not youths; they must have had the opportunity of maturing their minds by careful training, during which time frequent opportunities must have occurred for them to take up some fresh branch of their subject and work it out independently, with some originality in the methods they employ. Their confidence in their methods and results ought to have been sufficient to make them publish them, and so expose them to the criticism of the scientific public, who do not generally take long to form a fairly correct estimate of the abilities of authors. If all candidates for important posts were compelled to rely for their election on their works alone as testimonials, we are sure that the electors would be less trammelled, and more in a position to make judicious selections.

By some it may be remarked that what is wanted in the cases above instanced is good teachers, and that if men with original power can be obtained at the same time, so much the better; this requirement makes the general ability of the professor a secondary consideration in comparison with his teaching powers. We are of opinion that this is a mistaken view of the subject. Very frequently the most talented followers of scientific inquiry are not such effective lecturers at first sight as their less-gifted colleagues; still, we never knew a case in which there was not a peculiar charm about the teaching of a master-mind that gives an impulse to study on the part of the student, producing in the long run more beneficial results than the routine discourses of a mere expositor of other people's work. Another thing is that the connection of great names with a seat of learning in itself gives a stimulus to younger workers, raising success in mental work to a position which it is not easy for it to attain, on account of the fact that its results have frequently no immediate practical bearing.

In one at least of the cases we are referring to it is unfortunate in some respects that the electors have no special interest in the science they have so great a power indirectly to advance. In consequence of this their knowledge of the respective merits of the candidates must be uncertain, and we do not think that it will be much increased by the showers of testimonials which it is evidently the intention of more than one of the candidates to submit. One candidate has sent broadcast a lithographed form, sometimes even to men his junior in position and age, courting testimonials. What possibly can be the value of the pound's weight of paper he will probably thus accumulate? He ought to remember that no number of shots from a smooth-bore gun will send a ball as far as a single one from an Armstrong, and on that principle reduce the number and endeavour to increase the quality of the testimonials he sends in; by which means he will save the adjectives as well as the temper of his acquaintances.

Another candidate sends us the printed list of his published works, and to that we see no particular objection. But appended to each is a selected series of reviews, from which all the unfavourable ones are carefully omitted. It is, no doubt, unpleasant to print adverse criticism, but how can the electors be expected to form a correct estimate of the value of the works reviewed, if those in their favour only are introduced? The reviews, as one-sided, had been much better omitted, or, if printed, had much better have been inserted without selection. It is this extreme mode of action thus adopted which has called our attention to the subject.

On the whole, we think that the electors for the Scotch Science Chairs have a by no means easy task before them, and we sincerely hope that in their selection they will lay stress on soundness of judgment and scientific thought rather than on quires of testimonials wrung out of acquaintances and friends, who would much rather have been otherwise employed than in putting pen to paper for the purpose.

Moreover, we are of opinion that not only should a man's researches be taken into account in making an appointment to any science chair, but also that no election should be made without taking the opinion of those competent to form an estimate of the value of these researches.

THE RAINFALL OF BARBADOS

Report upon the Rainfall of Barbados, and upon its influence on the Sugar Crops, 1847-1871. With two Supplements, 1873-74. By Governor Rawson, C.B.

THIS Report gives the result of observations made since 1847, at a large number of stations well distributed over the island. The total area of Barbados is 166 square miles; in 1847, only three stations had been established, in 1873 there were 178, so that at present there is more than one gauge to every square mile. By this system the conditions of local rainfall have been, as it were, put under the microscope; and the store of information obtained after the suggestive manner in which it has been analysed in this Report, will be not only valuable to the sugar-planter, but interesting to the meteorologist.

The north-east trade-wind prevails at Barbados during three-fourths of the year, and most of the rain comes from that quarter. Heavy showers come at certain seasons from south-west and north-west, but generally fail to reach the eastern districts. Indeed it very rarely happens that rain falls at the same time, or in equal proportions, over the whole island; it has, therefore, been divided into two main districts, the windward, and chiefly highland, and the leeward, or lowland section.

With regard to the yearly rainfall of the whole island from 1847 to 1871, it has been found, among other results (1), that the rainfall of fifteen years was above the mean, that of ten years below it; (2) that the deficiencies were generally greater than the excesses above the mean, that is, droughts, when they happen, are heavy; (3) that, taking the thirty years 1843-72, no succession of wet or dry years in cycles can be traced, but rather an alternation of wet and dry years. No more than two dry years have occurred together, but as many as three and four wet years.

With regard to the monthly rainfall: the mean of all the months is under 5 in.; March is driest, October wettest. In wet years May contributes most to the excess, March least. March is the only month of which the mean rainfall in dry years has exceeded the average. In dry years the deficiency is generally spread over the whole year; in wet years the excess is generally confined to the rainy season (autumn). On the other hand, taking the seven wettest and the seven driest years of the period, we observe that in the wet years two-thirds of the excess proceeds from heavy rains in the dry season, and that in the dry years more than two-thirds of the deficiency is caused by three out of the same four months, viz. June, July, and May, and by October and May.

A comparison between the three highest and the three lowest rainfalls belonging to each month during the whole period of twenty-five years shows a remarkable uniformity of the relation between the percentages of the extremes; thus the difference between each average of the lowest months and each average of the highest amounts in none of the twelve months to more than 90 (May) or less than 65 per cent. (August and September).

Of the two stations, Binfield and Halton, lying respectively at 1,065 and 280 ft. above the sea, the former received on an average nearly 11 in. more rain in the year, and showed a greater monthly variability. The influence of elevation is interesting. A table of rainfall in 1870 and 1871, at various heights from 100 ft. up to 1,000 ft., shows an increase at every step of 100 ft. but one, and the total increase at 1,000 ft. amounts to 20·73 in. on the mean of two years. Two exceptions to this regular increment in the means for 1871-73, in supplement No. 2, are ascribed to the lower stations catching the westerly rains, which do not penetrate far inland.

In March, one-half more rain fell at night than by day. From June to November, the days are slightly the wetter, from December to May, the nights.

One of the objects of this inquiry is to assist those who are interested in calculating the character of coming seasons. For such a purpose the annual averages of each month are taken, after eliminating the exceptional months of very great or of very slight rainfall. The original averages are not affected more than 6 per cent. by this removal. Having the ordinary limits of monthly rainfall tabulated, and observing the general appearance of the weather, every planter can form *some* conjecture whether the coming month will be wet or dry.

Appendix No. 36 shows the influence of each month according to the rainfall, upon the crop of the same year, and upon that of the following year. Thus a man might fairly bet 9 to 3 that a wet February will be followed by a bad crop, and 8 to 1, the highest odds of all, that a wet September will give a good crop next year.

A wet year is followed almost invariably by a good crop in the following year; and it is found that by multiplying the total rainfall of the preceding year by 800 and adding 7½ per cent. if that year was a dry one, or subtracting 7½ per cent. if that year was a wet one, the crop may be calculated in most instances within 3,000 hhds., the average yield of the island being 45,000 hhds. The good chance of predicting so nearly the total exports of Barbados for the coming year cannot fail to be of value, and further experience will no doubt reduce the probability of error. Let us hope that other States may be led to undertakings of the same kind by this example.

F. A. R. RUSSELL

OUR BOOK SHELF

Manual of British Botany, containing the Flowering Plants and Ferns arranged according to Natural Orders. By C. C. Babington, M.A., F.R.S., F.L.S. Seventh Edition; corrected throughout. (London: J. Van Voorst, 1874).

WE cordially welcome this new edition of a "Manual of British Botany" which continues to hold its ground against all its competitors. We do not propose to discuss the rival merits of Hooker's, Bentham's, and Babington's hand-books; each has specialities in which the others are wanting; and each will, no doubt, long have its advocates and admirers. A special claim to popularity as a *field-book* is advanced by the present work on the ground of its portability; and a great advantage is alleged by those who use it to be presented by the practice of placing in italics a few words in the description of each species referring to the character by which it is more readily distinguished from its nearest allies. Comparing the work with the most recent of the earlier editions which we have at hand—the 4th, published in 1856—we find that it extends only to twenty-six pages more, notwithstanding the numerous additions made since that time to British botany, of which ample account has been taken in the present edition. The only alteration made in the primary classification (comparing these two editions) is the separation of Cannabinaceæ from Urticaceæ. The number of natural orders is six more than in Hooker's "Student's Flora," notwithstanding the union of Salicaceæ, Myricaceæ, Betulaceæ, and Cupuliferæ into the somewhat artificial group of Amentiferæ. The location of individual genera has also been in some cases revised, as the removal of *Narthecium* from Juncaceæ (Babington, 4th ed.) or Liliaceæ (Hooker) to Melanthaceæ. Referring to some of the more difficult genera, in which Prof. Babington is an acknowledged authority, we find the number of species of *Rubus* increased from 41 to 45, while that of *Rosa* is reduced from 19 to 11, and of *Salix* from 32 to 29. We have never been able to understand on what principle Characeæ find a place in a work devoted to "Flowering Plants and Ferns," by the latter term being apparently meant Vascular Cryptogams. Prefixed to the work is a useful Glossary not found in the earlier editions; but the author has wisely refrained from acceding "to the wishes of some young botanists by prefixing a short Introduction to Botany." With the numerous admirable works now at their disposal, students ought to have no difficulty in making themselves acquainted with the Flora of the British Islands. A. W. B.

Eclipses, Past and Future, with General Hints for observing the Heavens. By the Rev. S. J. Johnson, M.A., F.R.A.S., Rector of Upton-Helions, Devon. (Parker, 1874).

THIS little book is a combination of two distinct treatises; one a description of past and future eclipses; the other, a catalogue of celestial objects falling within the range of such small telescopes as amateurs frequently possess. Each of these, it seems, was originally of greater bulk, and intended for separate publication, but they have now been condensed into a single small volume. This has the merit, not very common in these days, of being more than a mere compilation; the ancient eclipses, including those in the "Saxon Chronicle" (of which the author tells us no description has hitherto been published), having been approximately computed for the purpose from the tables in the "Encyclopædia Britannica;" and the notices of the planets, double stars, &c., being derived from actual observation. The book is pleasantly written, and without professing to go deeply into the subject, may well find readers among those who feel a general interest in astronomy, but have no intention of making it matter of serious or accurate study, or of going much beyond the limits of a 2¼ in. telescope. It would have been improved (without departing from its sketchy character) by a little more fulness and explicitness of treatment in some places; for instance, in the description of the belts and satellites of Jupiter, and where the abbreviated symbols of the Palermo Catalogue are left unexplained. Some misprints, too, have escaped in the revision. The following extract may interest our readers:—"For those who have very large telescopes, and who are not disposed to take them to oriental climates, it would be useful to have records of the number of clear nights in different parts of the kingdom. By clear nights, let us understand nights cloudless, or nearly so, till 11 P.M., or else clear for a full hour or two. Formerly my observations were taken in South Lancashire, but since the early part of 1870 in Devonshire. In 1859, the number of nights clear, partly or throughout, was 60; in 1860, 43; in 1861 and 1862, 46 each; in 1863, 47; in 1864, 83; in 1865, 82; in 1866, 77; in 1867, 55; in 1868, 62; in 1869, 58; in 1870, 112; in 1871, 98; in 1872, 90; in 1873, 82."

The Human Eye. By W. Whalley. (London: J. & A. Churchill.)

IN this small work the author tells us that he has incorporated the substance of a lecture on the subject, together with additions in various directions. He discusses, in a popular manner, the eye in man, and adds many facts with regard to its structure in other animals. His remarks are mostly anatomical, and we are disappointed to see so little notice of many physiological phenomena connected with the power of sight, which bring out the beauty of the organ of vision in a way which can be understood by the most amateur of readers. There is a want of consecutiveness in many of the paragraphs and chapters, though as a whole the book is a very readable one. Many of the instances given are wanting in grasp; for instance it is remarked that "In some of the ichneumons or 'Pharaoh's rats,' as the Egyptians call them, in the coatimundi, which somewhat resembles the racoon, and in the mangre, the osseous orbital ring is incomplete, and in a group of minor quadrupeds, entitled the Hyracidæ, the malar, or cheek bone, constitutes a perfect orbital ring." It is well known that the orbital ring is complete in all the Quadrumana and many Ungulata, and that it is absent in most other mammals; why then take the particular examples, which are not particularly good ones, and lay special stress on them. The deductions drawn are of a strongly teleological nature, and we cannot do better than recommend the author's reperusal of his work for the refutation of one of his concluding remarks, namely, that "In reviewing this very imperfect and disconnected sketch of the structure of the eyes of the different classes of animals, we cannot fail to recognise the fact that the human eye far transcends, both in mechanism and power, that of every other animal." We however deduce that the condor can see further, that many animals have an extra eyelid, and some bigger eyes than man himself, showing that his is inferior instead of superior in many respects.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Early Contributions to Spectrum Photography and Photo-chemistry

1. MY first attempt at photographing the fixed lines of the spectrum was made in 1834. It was on paper covered with silver bromide. As mentioned in the *Philosophical Magazine*, May 1843, it proved to be a failure. In the summer of 1842, simultaneously with M. Becquerel, by using daguerreotype plates, I succeeded, and in the following March sent a drawing of the photograph to the *Philosophical Magazine*, which was published in May. At that time I did not know that M. Becquerel was experimenting in the same direction.

The great lines α, β, γ, less refrangible than the rest, and which M. Lamansky has recently re-detected by the aid of the thermo-multiplier, are given in that drawing. These in the diffraction spectrum must be bands of very considerable width.

2. Sometimes a person is deprived of fair credit for his labour by what may be termed public perversity. I experienced this in the case of the chlorine and hydrogen photometer. The principle of this instrument is, that chlorine and hydrogen obtained in equal volumes by the electrolytic decomposition of hydrochloric acid, are made to reunite by exposure to light. I described a simple instrument of the kind in the *Philosophical Magazine* for December 1843. It still remains the most sensitive of all photo-meters. Twelve years subsequently, Professors Bunsen and Roscoe modified it, and used it in their photo-chemical researches. In their memoirs, published in the Transactions of the Royal Society, they give full credit for the invention to me, and remark that by its use I had "succeeded in establishing experimentally some of the most important relations of the chemical action of light." They did justice in the matter, but not so the public. The instrument currently passes as their invention, not mine.

While speaking of photometers there is another to which I may allude. It depends on the principle that a solution of ferric oxalate is decomposed with evolution of carbonic acid on exposure to light. The carbonic acid may be measured or weighed by any of the ordinary methods. I described such an instrument in the *Philosophical Magazine*, Sept. 1857. Quite recently M. Marchand has published in his *Annales de Chemie* several experiments by its use, evidently unaware that it had been employed by me many years ago.

3. In 1843 I made photographs of the diffraction spectrum formed by a grating both by reflection and transmission, and published drawings of them. An account of this may be seen in the *Philosophical Magazine* June 1845 and March 1857. These were the first diffraction photographs ever made. They therefore preceded those of M. Mascart by many years. Of course they were not at all comparable with the very fine ones obtained recently by my son, Dr. Henry Draper.

4. In my memoir "On the production of light by heat" (Phil. Mag., May 1847), I established experimentally the following facts:—

(1) All solid substances and probably liquids become incandescent at the same temperature.

(2) The thermometric point at which some substances become red hot is about 977 Fahrenheit degrees.

(3) The spectrum of an incandescent solid is continuous; it contains neither bright nor dark fixed lines.

(4) From common temperatures nearly up to 977 F., the rays emitted by a solid are invisible. At that temperature they are red, and the heat of the incandescing body being made continuously to increase, other rays are added, increasing in refrangibility as the temperature rises.

(5) Whilst the addition of rays so much the more refrangible as the temperature is higher is taking place, there is an augmentation in the intensity of those already existing.

This memoir was published in both American and European journals. An analysis of it was read in Italian before the Royal Academy of Sciences at Naples, July 1847, by M. Melloni, which was also translated into French and English.

Thirteen years subsequently M. Kirchhoff published his celebrated memoir "On the relations between the coefficients of emission and absorption of bodies for light and heat." A translation of this memoir may be found in the *Philosophical Magazine*, July 1860.

In this memoir, under the guise of mathematical deductions, M. Kirchhoff, taking as his starting-point the condition discovered by Angstrom in 1854, respecting the relations between the emitting and absorbing powers of different bodies for light and heat, among other things deduces the following facts. I give them as they are succinctly stated by M. Jamin in his "Cours de Physique de l'école Polytechnique" (1869).

(1) All bodies begin to be red-hot at the same moment in the same space, and become white-hot at the same time.

(2) Black bodies begin to emit red rays near 525 C. (977 F.)

(3) The spectrum of solids and liquids is devoid of fixed lines.

(4) The rays first emitted by black bodies are red; to these are added successively and continually other rays, increasing in refrangibility as the temperature rises.

In his celebrated memoir, and in subsequent publications on the history of spectrum analysis, M. Kirchhoff abstains from drawing attention to the coincidences I am here pointing out, except that in a foot-note to his memoir he makes in a single word allusion to mine. But from this no one would infer what were really the facts of the case, and accordingly in the bibliographical lists subsequently published, in works on spectrum analysis, such as those of Prof. Roscoe and Dr. Schellen, my memoir is not noticed.

I earnestly solicit those who take an interest in the history of spectrum analysis to compare my memoir in the *Philosophical Magazine*, May 1847, with those published by M. Kirchhoff thirteen years subsequently, on the radiating and absorbing powers of bodies (Phil. Mag., July 1860), and on the history of spectrum analysis (Phil. Mag., April 1863).

JOHN WILLIAM DRAPER

University, New York, July 8

Sounding and Sensitive Flames

In NATURE, vol. x. p. 223, Prof. Herschel describes some experiments recently made at the Newcastle College of Science, whereby sonorous vibrations are produced in tubes by means of heated wire-gauze instead of the ordinary gas flame. Interesting as are these experiments, they are, however, by no means new. The influence of heated wire-gauze in giving rise to vibrations of air within tubes was, I believe, first published by Prof. Rijke of Leyden. In Kœnig's catalogue for 1865, Rijke's tube is advertised (No. 27) and the method of experiment described. The readiest way of making the experiment is to cut a piece of the ordinary fine iron-gauze to the size of a sixpence or shilling, and press it some three inches up a glass tube of corresponding bore. Almost any length of tube over one foot may be employed, so that notes of varying pitch can be obtained. The gauze is easily heated by a little alcohol flame at the end of a bit of quill tubing. Employing platinum-gauze heated by an electric current, or a gas flame resting above the gauze, the sounds can be rendered permanent. By one or other of these methods no doubt many of your readers have, like myself, often repeated this experiment during the last six or seven years.

I notice also that Prof. Herschel has kindly attributed to me a modification of the ordinary sensitive flame; the credit of this belongs to Mr. P. Barry, of Cork. This arrangement simply consists of a sensitive flame burning on wire gauze, instead o directly from the gas jet. It was described in NATURE, vol. v. p. 30, and some further experiments on this kind of flame are to be found in the journal of the Franklin Institute for April 1872.

Perhaps it is not out of place to add here that when a sensitive flame under the influence of sound is viewed in a moving mirror, the state of its vibration, thus seen, reveals some interesting facts. Under such circumstances, the flame is capable of showing the nature of the different vowel sounds, and further, by the broken appearance of the flame one is able to detect sonorous vibrations too faint to be heard and too feeble otherwise to affect the flame. I have given a representation of the flame seen in a moving mirror on the plate appended to an article in the *Popular Science Review* for April 1867. The flame that is most suited for the vowel experiments happens to be the parent of the family of sensitive flames, and is described in a little paper of mine in the *Philosophical Magazine* for March 1867.

W. F. BARRETT

Science Schools, South Kensington, July 27

Aid to Private Research—Circulation of Scientific Memoirs

THERE are many scientific students scattered through the country, as science-masters in schools, and in other capacities, who are willing and competent to undertake original researches in their special branches of science. The great obstacle to their attempting it is, in most cases, the cost of the necessary instruments. It is of course impossible to expect such apparatus as is required for original work to be supplied from the science funds of a school, these being properly applied to provide only what is requisite for teaching the pupils; so that if an investigation is to be attempted, the whole cost falls upon one who is probably just beginning life, and is quite unable to afford it. The work is therefore postponed for a considerable period, and perhaps is given up altogether. Now the Department of Science and Art grants aid in fitting up the schools which are under its control. If the Department would give similar aid towards purchasing expensive apparatus for research, or would allow competent workers to hire such instruments for the period they require them, much of the difficulty to which I have alluded would be removed. Many, I am sure, would be glad to avail themselves of the opportunity, and would willingly fulfil the conditions necessary to ensure the safety and proper use of the apparatus. I may remark that by this means it would probably be easy to organise to a certain extent the investigations to be carried on, and thus render the results far more valuable than they would be if isolated. Looking to the national importance and the unremunerative character of this kind of work, few will think that this appeal is exorbitant.

I wish to allude to another point, to which attention has already been drawn in your correspondence columns (NATURE, vol. viii. pp. 506, 550). A scientific man, unless he is fortunate enough to be within easy distance of a large scientific library, is practically debarred from reading even the most valuable memoirs that are published. Abstracts, indeed, he may see; but these only serve to remind him that if he would get the original memoir for himself, he must purchase with it matter which is useless to him, but perhaps of the highest value to a worker in another branch. If these memoirs could be purchased in a separate form—or even if collections of papers bearing upon closely related subjects could be obtained—another cause of the costliness of science would be removed.

It has occurred to me that something ought to be done amongst ourselves to remedy our position as regards the transactions of the learned societies and the scientific periodicals. Could not a book-club be instituted, the members of which, upon paying a small annual subscription, should receive in turn the chief scientific periodicals? Or would it be more easy for a number of us who happen to take in different journals, to exchange them? If any of your readers should be inclined to co-operate with me in initiating either of these schemes, or to furnish any suggestions on the subject, I should be glad if he would communicate with me.

Sherborne, Dorset, July 11 H. W. LLOYD TANNER

Photographic Irradiation

As the question of whether irradiation is due to the imperfection of the instruments, or to an action taking place within the thickness of the collodion film, is a matter of considerable importance in all cases in which photography is made use of for the purposes of accurate measurement, I have repeated and somewhat varied the experiments which have lately been described in NATURE, vol. x. pp. 205, 223, by Mr. Ranyard. I therefore laid on a uranium dry plate a piece of platinum foil, and with full aperture of lens took, with an exposure of twenty-five minutes, a photograph of a piece of cardboard, in which were four parallel slits, hung against a background of bright sky. In spite of the long exposure, the images of the slits are sharply cut off at the place occupied by the edge of the platinum foil, though at the same time there are very marked traces of the outer hazy irradiation arising from reflection from the back of the plate. I then took with the same exposure, and under what seemed to be similar conditions of illumination, a photograph of the same cardboard sheet, on an extra-sensitive Liverpool plate, and again found that the images of the slits were sharply cut off. This seems to me to decisively show that the irradiation cannot be due to a spreading within the film, caused by the light dispersed from the highly illuminated particles in the collodion, as suggested by Mr. Aitken; and I feel inclined to agree with Lord Lindsay and Mr. Ranyard that it must be due to some cause that has its seat of action in front of the collodion film.

Bedford W. C. CROFTS

Feathering in Flint Weapons

IT is now some years since I first noticed the fact that in a number of flint weapon heads in my possession a distinct spiral could be traced in the form, this being evidently due in part to the direction of the line of fracture in the flint, but also in part to an exaggeration of this by the hand of the workman. In the last number of the *Scientific American* is depicted an arrow-head with the edges very distinctly feathered, so that if the weapon with which it was armed was propelled with any great rapidity, its revolution would be a matter of necessity and would result in a greater steadiness in its line of trajectory.

After having ascertained that my own weapons were all twisted, I examined a number of others with the view of ascertaining if the same spiral existed in them, and in all I found that there was something like it, and the more finish they presented the more twisted they were.

A very simple method enabled me to show the twist well. I pressed a flint between two pieces of greased pipeclay, then removed it carefully and filled its place with liquid plaster of Paris. Cross-sections of this cast in various directions showed the twist to perfection, and I found that the two wings of the flint were twisted in opposite directions though identical in relation to the axis of rotation), and that the curvatures were identical with those seen in the iron arrow-heads provided with wings which are used in many savage countries to this day, and were till lately, if indeed they are not still, made in large quantities in Birmingham. The most perfectly twisted stone arrow-head which I have yet seen is one made of quartz, where the line of fracture could not help the manufacturer in the least, and where it must have been the result of deliberate workmanship. It was an American weapon. The line of fracture of flint always gives a more or less pronounced spiral, and this may be one of the many reasons for its having been almost universally selected as the material for arrow-heads when it could be got. In fact, it is a difficult thing to find a flint flake of any size which has not a very evident spiral form, and I have a photograph in my possession of two weapons which I have examined and which are almost identical, one found without its shaft near Bridlington, in Yorkshire, and one with its shaft found in the hands of a native of New Zealand; and it would be impossible to tell, from the style of manufacture, which weapon belonged to which country. It is impossible to regard this as mere coincidence, but we must look on it, in each case, as an independent discovery of the principle of the rotation of the rifled projectile.

LAWSON TAIT

LOCALISATION OF FUNCTIONS IN THE BRAIN

AT one of the last meetings of the Royal Society, Dr. Burdon-Sanderson related the results of experiments he had recently made with a view to the further investigation of the important discovery of Hitzig and Fritsch, that there are certain spots on the surface of the cerebral hemispheres by the excitation of which the muscles of the opposite side of the body can be thrown into combined action.

It is well known that Dr. Ferrier, of King's College, who has studied the topographical distribution and limitation of these active spots or areas with great minuteness on a considerable variety of animals, has founded upon his experiments a theory that these spots correspond to organs situated at or near the surface of the hemispheres, and that it is the function of these organs to originate combined voluntary movements. Dr. Ferrier has accordingly proposed to call them "motor centres."

As, however, the facts appeared to Dr. Sanderson to be quite as consistent with the view previously entertained by physiologists that the function of co-ordinating voluntary movements is localised lower down in the cerebro-spinal centres, he thought it necessary to ascertain, with reference to some of the most characteristic combined movements produced by stimulation of the surface of the brain, by the interrupted voltaic current (Hitzig and Fritsch), or by induced currents (Ferrier), whether the very same combinations of movements could not be produced after ablation of the grey substance in which the "centres" for their production were supposed to be contained. If it could be shown that after complete removal of the "centres," the effects to the production of which they were supposed to be essential could still be observed, this would go far to prove that the facts had been misinterpreted; and if it could be further shown, not only that the phenomena might present themselves in animals deprived of the centres from which they were supposed to originate, but that they could be produced in such animals by the same methods and under the same circumstances as in normal animals, this would go far to negative the existence of any organs at the surface of the brain to which the term "motor centre" could with any propriety or accuracy be applied.

In accordance with these considerations, Dr. Sanderson planned experiments, in some of which the superficial convolutions containing "centres" were removed, while in others the whole of the anterior part of the left hemisphere as far down as the outer portion of the *corpus striatum* was taken away with the aid of a sharpened spoon. In each case it was found (1) that when after the removal of the cortical grey substance, the cut surface of white substance is excited by induced currents, movements of the opposite side of the body are produced, which are of the same character as those which result from excitation of the natural surface; (2) that the excitability is limited to certain spots, which can be as sharply defined as those demonstrable on the natural surface; and (3) that the relative positions of the active spots on the cut and natural surfaces respectively correspond closely with each other.

Simultaneously with the publication of Dr. Sanderson's communication, a paper appeared in Eckhardt's *Beitrage*, in which an account was given of very similar experiments, of which the results, though incomplete, corresponded, so far as theory went, with those above related. We learn also that Prof. Hermann of Zurich has also made experiments which have led him to reject in the most unequivocal manner the conclusions of Hitzig and Fritsch.

THE FORM OF COMETS*

II.

LET us see what ideas, what explanations have been suggested by the aspect of these monstrous phenomena, so evidently subject to the influence of the sun.

On examining comets, the first idea which is presented to the mind is that the head of a comet is the seat of an emission of matter which takes place in a direction opposite to the sun; it seems as if the comet fused at one end, and that the matter thus thrown off is arranged into an immense plume, exactly like the smoke which escapes from the chimney of a steamer at full speed. Let us examine this analogy more closely, and suppose, first, the boat to be motionless, with the smoke ascending vertically in a perfectly calm atmosphere. Each puff of this smoke is sent into the air with a certain speed, and the successive sections of the vertical plume thus formed will represent the positions which these puffs will have reached at the same instant. The puffs first emitted will be the highest; the latest ones will be lowest; if then we knew the law of the ascending movement of any puff, we should thus be able to assign the instant at which each section of the vertical plume was shot forth. Meantime, should we set the steamer moving in the motionless air, the place at which each section is emitted will gradually advance; each of these will ascend almost vertically over its place, for the speed of the horizontal movement which the boat communicates to it will be very rapidly exhausted in resisting the motionless air, and at the end of a certain time these puffs will be found dispersed in an inclined plume, presenting a curvature more or less marked. At first, this curvature will assume a vertical direction, *i.e.* the direction of emission.

---

* Continued from p. 229

On the other hand, the successive puffs, in ascending, tend to spread out; the earliest and highest must then become rarefied and disappear from sight. The tail,—no, I should say the plume of smoke thus formed, must become less and less dense, at the same time becoming less and less distinct and gradually getting obliterated.

Does it not seem as if here we had put our finger upon a complete analogy? The comet proceeds on its way like a steamer; it describes round the sun an orbit elongated like the path of a bomb; heated more and more by the solar rays, its matter is expanded and escapes into space, like that of a rocket. Is it not natural that it should send off a plume analogous to that which escapes from the funnel of a machine in motion? If we knew the rate of emission of each puff of cometary vapour, would we not be able to calculate the place which it must occupy in the tail, and even the form of the tail itself? Reciprocally, after having carefully determined the figure of this tail, would we not be able to form some estimate of the rate of the nucleal emission of the comet? Such, very nearly, was Newton's point of view in studying these magnificent phenomena. The comet of 1680, which appeared in the time of Newton, had a tail of 25,000,000 leagues in length; it forcibly impressed this great geometer, and originated in his mind views similar to the analogy which we have just indicated.

But analogy is not always a perfectly trustworthy guide. Here the differences preponderate considerably over the likenesses. We have certainly in the heavens a heated body which in its progress emits vapours like a gigantic steamer; but where is the funnel, where is the atmosphere? And, remember, the atmosphere here plays an important part, for it is its presence which determines the ascent of the puffs of smoke. If these ascend, it is from the same cause as balloons, because they are lighter than air. Take away the air, instead of mounting they will fall. Well, in the sky there is no air; space is void of matter forming a continuous and ponderous medium, layer on layer, until the surface of the sun is reached. Moreover, Laplace has shown that the power of the sun in attracting a ponderable fluid will not extend beyond a very narrow limit. As to the ether of the physicist, it need not engage our attention for an instant, since, by definition, this hypothetical ether is imponderable. We shall not be much astonished that the genius of Newton should have been content with a similar analogy, if we only reflect on all the difficulties which the doctrine of attraction raised in the minds of the eighteenth century, and on the Cartesian prejudices which greeted its first appearance on the Continent. What would have happened if, at the first, the too absolute terms of this doctrine had seemed to be contradicted by the phenomena of the figure of comets? It was then necessary, at any cost, after having incontestably connected the movement of these bodies with the new doctrine, to let it also be seen, even though it was by an analogy somewhat forced, that their figure could be explained in the same manner.

Now that the doctrine of attraction is established on an immovable foundation, our mind is able to detach itself from the purely metaphysical part of the original affirmations, which presented it to us as the single force to which all celestial phenomena ought to be subordinated. But before invoking another force, it is necessary at the very outset to draw from attraction all the consequences applicable to comets; and we shall do so by showing that the force, which seems constantly to tend to unite, to agglomerate scattered material, is, in reality, also quite capable of producing in certain cases the opposite effect, viz., of undoing existing agglomerations.

To proceed in order, let us ask, first, why comets have tails while planets have not. Is it because comets approach closer to the sun and are thus subjected to a very powerful heat? Certainly not; for the planets Venus and Mercury, especially, are constantly closer to the sun than most of the comets at their perihelion, and yet neither Venus nor Mercury has the faintest trace of a tail. Must we attribute the figure of comets to the parabolic nature of their orbits, in virtue of which their distance from the sun varies enormously, while the planets remain always very nearly at the same distance from the centre of our solar system? An illustrious poet, Lamartine, wishing to depict a creator of the earth, indifferent to his creature, has beautifully said—

> Et d'un pied dédaigneux la lançant dans l'espace,
> Rentra dans son repos.

If the kick had been stronger, the earth would have been sent to describe a cometary orbit round the sun, *i.e.* an elongated ellipse or a parabola, instead of the circle which it now describes; but, for all that, it would not have become a comet, it would have had no tail. Do you know what shape would be the result on this supposition? The imperceptible solar tides of the ocean would be gradually restrained in proportion as the earth increased its distance from the sun, and soon would disappear altogether; our atmosphere would be more and more condensed into layers always spherical and concentric with the earth; our planet would be lost in the depths of infinite space without any other change than a more marked contraction due to the predominating cold of space.

Are comets, then, formed of matter different from that of the planets? No; such an idea cannot be accepted now that spectrum analysis has told us of the existence of sodium, magnesium, and calcium in the sun, hydrogen in the stars, and our ordinary gases even in the most distant nebulæ. Above all, we find the same elements subject to the same mechanical, physical, and chemical laws.

The truth is more simple. If our planets have no tails, it is because they have an enormous mass; if comets have tails, it is because their mass is extremely small, and because the attraction which this mass exercises upon their materials is not sufficient to hold them back and to overcome the external forces which tend to decompose them.

Now have we hit upon a notion which I must dwell upon all the more that it has not hitherto been sufficiently popularised. You have heard of a general law in the world of organised and living beings, called "the struggle for life," the fight or effort which it is necessary to make in order to live, *i.e.* to resist the external forces which tend to death. Those that have in themselves a sufficient resisting force are developed and found persistent races; the feeble succumb and disappear. The same law reigns in the heavens. A body would subsist eternally by virtue of its internal forces if it were alone; but every neighbouring body becomes for it a dissolving cause by virtue of the attraction which the former exercises on the latter. The strong resist; they are the planets: the weak yield and end by succumbing; they are the comets.

Mechanics will convince us of this. Let us take a comet far away from the sun, leaving out of consideration at first the very weak attraction to which the former is subject; we can do this, for it is then sensibly the same for all its parts. Its solid, liquid, or gaseous materials are under the influence of their mutual attractions and of the feeble heat which they receive from without, freely disposed in regular layers, superposed so as to form a globe spherical like the earth, a globe whose centre will be occupied by the most compact parts and whose surface will be formed of the lightest parts. Whether this globe be at rest or in motion, if things remain thus, the comet will subsist; you will see its bright nucleus surrounded by a less luminous but quite sunny nebulosity, and this same form will indicate to you a body in which the forces which act on all its parts are directed towards the centre. Such is the first form in which we have represented Donati's comet (Fig. 3).

But if the comet comes nearer to the sun, the solar attraction will rapidly modify this state of things. The parts nearest to the sun will be attracted more strongly than the centre, and will have a tendency to separate from it; the difference of the solar attraction on the various parts of the comet will have the effect of elongating that body somewhat in the direction of the radius vector; this is a phenomenon quite like that of the tides. The second sketch (Fig. 4) of the comet of 1858 offers an example of this; but already the eccentricity of the nucleus ought to put us on our guard against any incompleteness in our present reasoning, founded upon the sole consideration of attraction. Nevertheless, you see, the body remains entire; the solar action being very feeble, at that great distance, the attraction of the comet on its exterior strata still preponderates, and the resultant of these various forces at each point is still turned towards the interior; the layers which compose it are everywhere convex externally, and do not show any symptoms of dissolution.

But bring the comet still nearer to the sun; the attraction of that body will no longer be limited to the production of an elongation; you will see the external layers become still more deformed and finally open out so as to let matter escape.

There exists, for every body placed within the sphere of action of our sun, a surface limit beyond which its matter may not pass, under pain of escaping to that body and falling within the domain of the solar action. This surface limit depends on two things—the mass of the body and its distance from the sun. For a planet like the earth, whose mass is so considerable, this surface limit is very distant, and yet, within the still terrestrial region of its satellite, the moon, a child could lift, without much difficulty, a body which would weigh for us 36,000 kilogrammes, so feeble does the attraction of our globe become at that distance of 60 terrestrial radii. A little beyond the lunar orbit, a body would cease to belong to the earth, and would enter the exclusive domain of the sun. But for a comet, this surface limit is much nearer the nucleus, and, moreover, it draws nearer and nearer, in proportion as the comet approaches the sun. One of the most eminent professors of the high education, M. E. Roche, of Montpellier, has submitted this question to analysis, leaving aside accessory circumstances such as the rotatory movement of the body under consideration and the curvature of its trajectory; he has thus been enabled to discover that the surface which so limits a body in the vicinity of the sun presents two singular points in the direction of the radius vector, setting out from which this surface is widened out into conical network, in such a manner that the dissolution of a body the matter of which reaches or passes beyond these boundaries, is effected principally in the vicinity of the points referred to, flying, so to speak, into two pieces, thus obeying at once the attraction of the comet and especially the thenceforth preponderating attraction of the sun.

And it ought not to be objected to this that there is no reason why the matter of a body should tend thus to be separated from its centre and to fill a volume greater and greater, so as to reach or surpass the fatal limit. This tendency exists; it proceeds from the increasing heat which a body that approaches nearer and nearer to the sun experiences, and from the progressive expansion which thence follows in the matter. Certainly if the earth were drawn nearer to the sun, the dilatation of its solid nucleus would be a small matter, but thenceforth the seas would be reduced to vapour and would pass wholly into the atmosphere. In the case of comets, in which the matter presents a much less marked degree of aggregation—doubtless because its original heat, due to the union of the particles which compose it, was not sufficient to bring about all the chemical reactions—the solar heat produces an expansion comparable to that of gases. According to my calculations, this expansion dilates the radius of the concentric zones which we can distinguish so well in the head of Donati's comet, at the rate of 19 metres per second. So long as these zones remain in the interior of the surface-limit, they are not dissolved; but if they should happen to go beyond it, their materials go off at the bidding of the sun's attraction.

Thus all the conditions of instability are found united in comets. Their mass is extremely small, and, consequently, the surface limit is very near the centre of gravity. Their distance from the sun diminishes rapidly in the descending branch of their trajectory; consequently this surface limit becomes more and more contracted. Finally, their enormous volume tends unceasingly to dilate, because of the increasing heat of the sun, and to cause the cometary matter to shoot out beyond this surface limit.

What becomes of this matter after it is set free by the action of the sun? Having escaped from that of the comet, it will none the less preserve the original speed, *i.e.* the speed which the comet itself had at the moment of separation; this speed will scarcely be altered by the feeble attraction of the cometary nucleus, or by the internal movements of which I have spoken, since these are measured by a few metres per second, while the general motion round the sun takes place at the rate of 10, 15, 20 leagues and more per second. The molecules, separated and thenceforward independent, then describe isolated orbits around the sun, differing very little from that of the comet. Those which are found in advance go a little faster and take the lead; those which are behind remain a little in the rear; so that the abandoned materials are divided along the trajectory of the comet in front and in rear of the nucleus. In time these materials are separated considerably from the body from which they emanate, and are more and more disseminated; but considered at the moment of emission, they will form two visible appendages, two sorts of tails opposed and stratified on the orbit of the comet.

We touch here on the decisive point of our research. To take the final step it will be sufficient for us to consider the two figures 6 and 7. The first represents the successive shapes C, C′, C″, which a comet must take, according to the preceding theory, if there were no other force in play than that of attraction. Fig. 7 represents the actual fact, *i.e.* the forms which a comet assumes in reality according to its progress in its orbit round the sun, S. Evidently there is no resemblance between these two series of figures. Then the preceding theory fails in some point, and as the error will not have been in the part attributed to attraction, it must be found in the assumption that this is the only force. In other words, it is sufficient to compare the effects of attraction with the real facts, to be convinced that there must be another force at work in the cometary phenomena. And as the former would be capable only of disseminating the matter along the orbit, the new force must be capable of driving this same matter in the direction of the radius vector; it must then be opposed to attraction; it must repel and not draw. What may this force be? Ought it not to make itself felt elsewhere than in the gigantic tails of comets? How can the same body, the sun, at once attract and repel matters of the same origin? And how does it come to pass that since it acts so powerfully on the matter of these bodies, this repelling force of the sun does not change the movement of their nuclei which appear to follow so faithfully the laws of solar attraction? This last question will put us on the right track.

And first, do comets follow rigorously, like planets, the laws of attraction? That the law has been firmly established in the case of the planets, I cannot doubt, for we have for these bodies a historic series of observations going back to the Chaldeans and including thousands of revolutions of each of them. If there had been the least disagreement between the phenomena and the law to which they are assigned, the disagreement, no matter how small, must at length have become sensible, after accumulating during so lengthened a period. But comets, in general, appear only once; we only see them and can only observe them in a very restricted part of their orbit; so that should a very slight influence alter their movements, its effect would be confounded with the inevitable errors of observation, and astronomers would not be able to distinguish it. There are, no doubt, some periodic comets, such as those of Halley, Biéla, Encke, &c., but the first has a period of seventy-five years, so that in going back to its earlier appearances, we very soon reach the time when comets belonged to the domain of astrology. That of Biéla has a period of 6¾ years, but its first certain appearance dates only from the end of last century, and in the course of that time a singular accident has happened to it: it has been divided in two. There remains Encke's comet, the only one which can be subjected to the verification of which we have spoken, on account of the numerous revolutions which it has accomplished since its discovery in 1786. Well, it is found that this comet, the only one which can be tested in the way we speak of, does not follow exactly the laws of gravitation. According to these laws, when we have taken account of the perturbations caused by the neighbouring planets, the time of revolution ought to be constant, while, in fact, it diminishes regularly during each revolution; the effect established in this instance is of considerable magnitude, about half a day.

FIG. 9.

In face of such a fact there is room for the question under consideration, viz., Is attraction the only force which governs the universe? But how can we formulate such a doubt, when the carefully-studied movements of the planets may be perfectly accounted for, for thousands of years past, exclusively by the theory of attraction? We can escape the difficulty by an artifice identical with that which enabled Newton to account for the tails of comets by attraction alone: I refer to that vast and rare atmosphere which Newton placed in space around the sun, and in the midst of which the cometary materials are elevated, according to him, exactly as the smoke of our chimneys in our terrestrial atmosphere. Geometers, then, introduced the resistance which this general medium ought to oppose to the progress of a comet on account of its small density, while the same medium would oppose only an insensible resistance to the planets on account of their relatively small volume and their enormous density. It is a remarkable fact that the analysis founded on this impossible hypothesis perfectly accounts for the anomaly proved to exist in the orbit of Encke's comet, viz., its progressive acceleration. I feel bound to question this analysis, and to show (1) that its primary basis is radically false, since it leads to the admission that a material and ponderable medium may remain immovable around the sun; (2) that the conclusion of this analysis, so far as it is valid and conformable to observation, simply proves that there must exist an action opposed to the movement of the comet and directed along the tangent to its orbit. Various causes, moreover, may lead to the same conclusion, and differ only, as to other effects, in quantities difficult to appreciate. But we learned above, from the phenomena of the tails, that there also exists an action in the direction of the radius vector. The resisting medium of Encke, or the immense solar atmosphere of Newton, being physically impossible, I have been led, by two different ways, to a new force which would satisfy these data by producing the two actions or components above mentioned: that which expels the cometary molecules in the direction of the radius vector, and that which acts upon the comet in the inverse ratio of its tangential velocity.

FIG. 7.

(*To be continued.*)

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"*

VI.

IN no animal has the study of cranial development yielded richer results than in the frog. In tadpoles, from the time of hatching onwards, such points as the true nature of the trabeculæ, and their distinctness from the investing mass, the fact that the stapes is a segmented portion of the ear-capsule, and not the apex of the hyoid arch, and the relations of the pterygo-palatine arcade have been demonstrated with certainty. Most instructive, also, is the way in which the various arches become segmented, altered in shape, direction, and relative size, and made to subserve the most various functions.

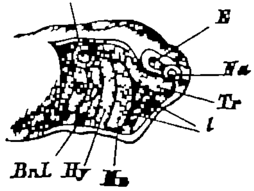


Fig.17.

FIG 17.—Head of Tadpole 2–3 lines long, with the facial arches exposed by removal of the skin from the left side (× 6½).

Besides the adult, nine stages of the frog's skull were described.

1. (Fig. 17).—In tadpoles at about the time of hatching the whole organism is in a very rudimentary condition. The mouth and the gill-slits are closed, the dehiscence of the tissue between the facial arches by which they are formed not having yet taken place. On the first and second branchial arches small papillæ, the rudiments of the external gills, have made their appearance (see Fig. 17). The little creature, now about a quarter of an inch or less in length, is usually found attached to water weeds by the horseshoe-shaped sucker beneath its throat, which, though serving the same purpose, must on no account be confounded with the suctorial mouth of the lamprey. The facial arches are in a perfectly simple and undivided condition, all those behind the mouth are curved slightly backwards in the lower half, while the trabeculæ incline forwards and are thus made to diverge considerably from the mandibulars, although in their upper portion they have almost exactly the same inclination as their successors in the series. The investing mass consists of two small patches of nascent cartilage, one on each side of the notochord. The auditory are the only sense-capsules which have undergone chondrification, and in them the process is quite incomplete, a large membranous space being still left uncovered by cartilage. Two pairs of labial cartilages (l) are formed, and probably answer in a general way to the first and fifth of the series described in the shark (see Fig. 2, l^1, l^5).

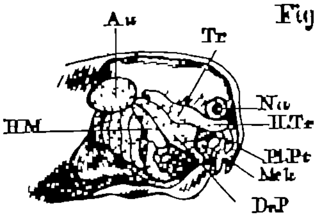


Fig 18.

FIG. 18.—Head of Tadpole, 5 lines long (× 6½). Or.P. Orbitar process.

2. Tadpole about ⅓ in. long). The external gills have now (four or five days after hatching) become plumose and the mouth and branchial clefts open freely into the pharyngeal cavity. The most important advance is in the commencing separation of a small segment (hypo-mandibular) from the second arch, which in the next stage has become Meckel's cartilage. The hyoid has also begun to diverge from its predecessor in its lower part, and a fourth branchial arch has appeared in addition to the three observable in the first stage.

3. (Tadpole about ½ in. in length, Fig. 18.) The trabeculæ have now united with the investing mass and with each other before and behind the pituitary body, and have become almost horizontal; they likewise begin to foreshadow some of the changes which afterwards take place in them, becoming slender anteriorly, to form the cornua trabeculæ (H.Tr), and just behind the olfactory sac being thickened slightly in the future ethmoidal region. Meckel's cartilage now forms a true articulation with the fixed or suspensorial portion of the arch to which it belongs; slightly above the articulation two processes are sent out from the suspensorium; the outer (Or.P) is the *orbitar process*, while the inner (Pl.Pt), uniting with the trabecula, forms a commissural band of cartilage, the rudiment of the pterygo-palatine arcade: between these two processes, the second and third divisions of the trigeminal nerve run. The hyoid arch has assumed a wonderfully shark-like character (see Fig. 2), having divided into an upper and a lower segment, the former of which (hyo-mandibular, H.M) has come into close relation with the preceding arch, while the latter hangs free, forming an open angle with the mandible, and unites with its fellow of the opposite side by means of a median basihyal. The investing mass and ear-capsules are now completely cartilaginous.

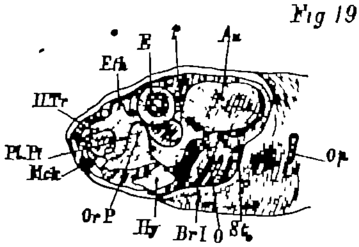


Fig 19.

FIG 19.—Head of Tadpole, 1 in. long (× 4½). Op. Opercular aperture

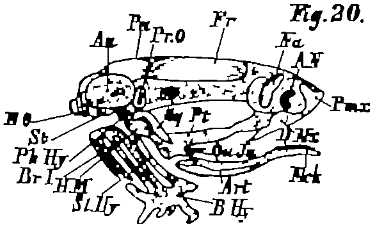


Fig.20.

FIG. 20.—Skull of Young Frog, with tail just absorbed (×) 5).

4. (Tadpoles 1 in. long, Fig. 19.) At this stage the hind limbs have made their appearance, and the opercular fold has completely grown over the gill arches on the right side, a small slit (Op) still remaining on the left. The cranial elements have now assumed somewhat the appearance of a skull, which however differs most markedly from that of the adult frog. The trabeculæ, by complete union in their hinder two-thirds with each other and with the investing mass, have formed a solid *basis cranii;* they have also sent up a low wall on either side of the brain, thus tending to inclose it, and just in front of their union with the pterygo-palatine have developed a prominent transverse ridge (Fig. 19, Eth), the rudiment of

---

* Continued from p. 168.

the ethmoid. The suspensorium is still greatly inclined forwards, so that the quadrate lies immediately under the ethmoidal region, and, consequently, the palato-pterygoid and Meckel's cartilage, though lengthening, are still extremely short. The hyo-mandibular has completely coalesced with the suspensorium, which is now therefore a compound structure, and presents above two of the three processes mentioned in the axolotl, namely the pedicle (p) and the otic process (o), the latter at this period belonging equally to both arches, the pedicle to the mandibular only. The branchial arches have united with one another above and below to form a perfect branchial basket. The stapes (St) is now completely cut out of the wall of the ear sac, and the first ossification has made its appearance on the base of the skull, in the position of the para-sphenoid.

5. In tadpoles in which the legs have increased greatly in size and the tail has begun to shrink, a marked advance has taken place in the proportion of the jaws to the rest of the skull; the mandibular pier has moved downwards and backwards so as to lie at an angle of 45° with the skull-flow, and the palato-pterygoid and lower jaw are correspondingly lengthened. (Fig. 20 shows the process further advanced.) The orbitar process is greatly decreased in size and lies higher up on the suspensorium, and the ethmoidal cartilage has sent out a vertical keel-like plate (the septum nasi) between the olfactory sacs.

6. The tadpole has now moulted its larval skin, so as to expose the fore-limbs, and the tail is reduced to half its original size. The walls of the brain-case, commenced in the fourth stage, are now complete, and by their union above have formed a roof, interrupted only by their membranous fontanelles, which are persistent in the adult, one in the frontal, and a symmetrical pair of smaller ones in the parietal region. The septum nasi is complete, and two wing-like processes growing from it have inclosed the nasal capsules by uniting with the floor formed by the greatly expanded hypo-trabeculars. The hyoidean portion of the otic process (Fig. 19, o) has now freed itself from its connections, and appears as a triangular nodule of cartilage, the pharyngo-hyal (Fig. 20, Ph.Hy), or detached apex of the arch; at the same time the remainder of the coalesced portion (Figs 18 and 20, H.M) begins to show signs of separating once more from its union with the mandibular pier. Besides the para-sphenoid, the parietal, frontal, nasal, pre-maxillary, maxillary, squamosal, articular, and dentary ossifications have appeared.

7 (Fig. 20). The skull of young frogs in which the tail has just disappeared differs from that described in the last stage, chiefly by the extension of the centres of ossification already mentioned, and the appearance in addition of the exoccipital, prootic, pterygoid, quadrato-jugal, and septo-maxillary. The free portion of the hyoid (St. Hy) has assumed the slender proportions which characterise it in the adult, and it is united by fibre to the upper part of the arch (H.M), which, although still fused with the suspensorium, is marked off from the latter by a distinct depression, and shows unequivocal signs of commencing separation.

8. A most important metamorphosis has taken place in this stage, which includes young frogs just commencing their first summer. The pharyngo-hyal or nodule of cartilage separated from its arch in the sixth stage (see Fig. 20, Ph.Hy) has now come into close contact with the stapes, although it does not actually articulate with it until the succeeding stage; this freed apex of the hyoid arch thus becomes the inter-stapedial piece (Fig. 16, p. 168, i.st) of the ossicula auditus, the representation of the *os orbiculare* of mammals. At the same time the next segment of the same arch (Fig. 20, H.M) has become completely separated from its connection with the suspensorium, and has taken on the form of the other three elements of the chain of ear-bones, the medio-, supra-, and extra-stapedials (Fig. 16, m.st, s.st, e.st), which together are the homologue of the mammalian *incus*. The malleus, although having its functional analogue in the extra-stapedial (the end of the chain fitting into the drum-membrane) is represented morphologically by the frog's suspensorial cartilage, being, as will be shown in a future paper, the proximal end of the mandibular arch.

9. The embryonic characters are now (first autumn) fast disappearing. The suspensorium is at right angles with the long axis of the skull, or almost exact half-way between the positions it occupies in the seventh stage (Fig. 20), and in the adult (Fig. 14, p. 168). The ossicula auditus have come into union with the stapes, and the stylo-hyal instead of being attached (as in Fig. 20) to the suspensorium, has grown backwards to its adult position, where, however, it is united only by fibrous tissue. The parietals and frontals are still separate, and the maxilla has not extended backwards to the quadrato-jugal, although the fibrous space between them is now quite small. The girdle-bone (Fig. 19, G) is singularly behindhand in its ossification; even at this stage it is represented only by a slender plate of bone immediately anterior to the frontals. At a further stage endosteal ossification sets up in the cartilage on either side of this region, so that the girdle-bone is formed by the coalescence of three separate centres.*

THE STRICKLAND CURATORSHIP IN THE UNIVERSITY OF CAMBRIDGE

THE Vice-Chancellor of the University of Cambridge has approved the nomination, by Miss Frances Strickland, of Apperley Court, of Mr. Osbert Salvin, F.R.S., to the office of "Strickland Curator," lately founded and endowed by that lady, and the Museum of that University will therefore reap the benefit of having attached to it one of the best English ornithologists of the day. Mr. Salvin, being then a scholar of Trinity Hall, graduated in mathematical honours in 1857, and immediately afterwards proceeded to join Mr. (now Canon) Tristram in the natural history researches he was making in Algeria, the important results of which are known to many of our readers. In the following autumn he sailed for Central America, and there began that series of scientific observations which has made him the chief authority on the zoology of that part of the world. How many times he has since visited it we cannot say, but he only returned from his last expedition some two months ago, and he has besides been all the while well occupied. In addition to the many papers he has published, mostly on the birds of the Neotropical Region, he has, in conjunction with Mr. Sclater, brought out an illustrated "Exotic Ornithology," intended as a sequel to the celebrated works of Daubenton and Temminck, and in 1870 was chosen editor of the *Ibis*, the leading ornithological periodical of the world.

But our object here is not to sound the praises of Mr. Salvin, who, it will be seen from what we have said, does not require them, but to point out the advantages that would accrue to science if posts for the study and promotion of its various other branches, similar to the recent foundation, were established in our Universities. We are greatly mistaken if the "Strickland Curatorship" is not the very first step that has been made towards a fulfilment of that idea of the endowment of research which has been often urged in these columns, and was especially recommended in the late Report of the Royal Commissioners on Scientific Instruction and Aid to Science. Admitting that the intention of Miss Strickland was mainly to secure the proper keeping of her late brother's ornithological collection, which was some years ago given by his widow to the University, what will be the effect of the foundation? The merely mechanical part of the curator's duties is slight. A collection once put in order is easily so retained. Even the cataloguing of it is a task that may not be expected to occupy an ornithologist of Mr. Salvin's ability, knowledge, and experience, a very long time—though catalogues in these days, to be worth anything, are more serious affairs than most people would fancy. The regulations of the office prescribe that its incumbent should then turn his attention to the other ornithological collections possessed by the University; and, even if the rest be trifling, the Swainson Collection may be expected to form a formidable undertaking—to say nothing of others that may be acquired from time to time. We take it for granted that the University will not allow such catalogues to remain in manuscript, but will print and publish them as they are completed. If so, it will be promoting the advancement of science in this particular direction in the most efficacious mode possible, and yet, be it remembered, not in a way that by any means can be termed "educational." The compilation of these catalogues will be purely a matter of research, and the amount of aid they will furnish to scientific ornithologists cannot be calculated. There can be little doubt that to the centre in which such good work is being done, many other collections will gravitate, and thus Cambridge will be for many years to come a recipient and disseminating focus of Ornithology.

---

* It should have been stated in the last paper that Fig. 13 is taken from a drawing kindly furnished by Prof. Huxley.

Now, even the most ardent ornithologist will hardly maintain that his favourite study is the most important in the wide round of the sciences, or even of those which have to do with biology. The moral of the "Strickland Curatorship" is, that similar appointments ought to be established to do for other sciences what that will do for Ornithology. And even now we have to mention a curious fact which should be an encouragement for future founders or foundresses to cast their bread upon the waters: two other benefits to this branch of science have unexpectedly been the result of Miss Strickland's endowment. The naturalist first selected by her for the new appointment was the learned Dr. Finsch, who, until the last few months, had been pursuing his unwearied labours on a scanty and uncertain pittance at Bremen. When the good people of that city learned that they were likely to lose his services, they bethought them that it was expedient to retain him, and to do this they resolved upon raising his stipend and making his office in their museum permanent. In like manner it happened that Miss Strickland's next selection, a young naturalist of great promise, was induced to stay at Berlin by the creation of a post in the museum there specially for him. Thus the benefactress of Cambridge has the satisfaction of knowing that her bounty has been the means of providing for two meritorious men, besides accomplishing the object she had directly in view. Will no one come forward to further the good work she has so well begun? Now that there is a rumour that one of our greatest living naturalists is likely to be tempted by a glittering bait to the other side of the Atlantic, it is in the power of many a one to preserve the glory of his services to England by founding a Professorship of Biological Research in the University of John Ray and Charles Darwin!

A NEW ORDER OF HYDROZOA

On the southern shores of France, at a slight depth below the surface of the sea, there may be found attached to stones small patches of one of the horny sponges which will probably arrest the attention of the zoologist by what will appear to him as an unusually obvious and well-defined condition of their efferent orifices or oscula.

If one of these patches be transferred to a phial of sea-water, the observer will soon be astonished by seeing that from every one of the apparent oscula a beautiful plume of hydroid tentacles will have become developed, and he will naturally believe that the form has at last been found which will remove all doubt as to the zoological position of the sponges, and decide in favour of the hydroid affinities recently assigned to them.[*]

A more careful examination, however, will show that the orifices on the surface have been incorrectly regarded as oscula, and that the tentacles form no part of the sponge, but proceed from an entirely different organism which is imbedded in its substance.

It will be further seen that the organism with which the sponge is thus associated is contained in a congeries of chitinous tubes which permeate the sponge-tissue, and open on its surface in the manner of genuine oscula, and it will be still further apparent that this organism, while undoubtedly a hydrozoon, and even presenting quite the aspect of a hydroid trophosome, is no hydroid at all, and cannot indeed be referred to any of the hitherto recognised orders of the Hydrozoa, but must take its place in an entirely new and as yet undefined order of this class.

The chitinous tubes and their contents are united by a common tubular plexus which lies towards the base of the sponge, and they thus constitute a composite colony of zooids. The tubes, towards their free extremities, where they open on the surface of the sponge, become much increased in width, and here their contents become developed into a very remarkable body, which has the power of extending itself beyond the orifice of the tube, and of again withdrawing itself far into the interior exactly like the hydranth or polypite of a campanularian hydroid in its hydrotheca. When extended, it displays from around the margin of a wide terminal orifice its beautiful crown of tentacles; but when withdrawn into the interior of the cup-like receptacle, the tentacles are greatly contracted and thrown back into the cavity of its body. Its general appearance, indeed, is very like that of a campanularian hydranth, and a careful examination is needed in order to show that it possesses all the essential characters, not of a hydranth, but of a medusa. It has a circular canal surrounding the terminal orifice and supporting the tentacular crown, and it has four symmetrically-disposed longitudinal canals extending from the circular canal backwards in the walls of the body. No manubrium could be detected, though this was carefully sought for at the point where it might be expected to be found, namely, where the medusiform zooid passes into the common cœnosarc which occupies the narrower portion of the tube; neither was there any appearance of a velum, nor of lithocysts or ocelli; but these are comparatively unessential modifications.

The reproductive system is probably developed in the walls of the longitudinal canals, but in none of the specimens examined was this part of the organisation sufficiently mature to admit of a satisfactory demonstration.

For the little animal thus constructed I propose the name of *Stephanoscyphus mirabilis*. Whether it is to be regarded as parasitically connected with the sponge, or whether the two are only accidentally associated, it is at present impossible to say. At all events, in no instance did I find the Stephanoscyphus unaccompanied by the sponge.

Stephanoscyphus may then be regarded as a compound hydrozoon, whose zooids are included in cup-like receptacles resembling the hydrothecæ of the calyptoblastic hydroids; but these zooids, instead of being constructed like the hydranths of a hydroid, are formed on the plan of a medusa. It has plainly very decided affinities with the Hydroida, but is nevertheless removed from these by a distance at least as great as that which separates from them the Siphonophora. It thus becomes the type of a new hydrozoal order, for which I propose the name of THECOMEDUSÆ.

GEO. J. ALLMAN

---

[*] See Haeckel's "Kalkschwämme."

ANOTHER NEW COMET.

THE following letter from Mr. J. R. Hind, dated Mr. Bishop's Observatory, Twickenham, July 27, appeared in Tuesday's *Times*:—

"M. Stephan, Director of the Observatory at Marseilles, notified to us by telegram yesterday the discovery of a comet on the previous night by M. Borrelly, a colleague of M. Coggia (to whom is due the first detection of the bright comet which we have just lost), at that Observatory. The position at 2 A.M. on the 26th inst. appears to have been close to the star Theta, in the constellation Draco, in right ascension 238 deg. 4 min., and polar distance 30 deg. 28 min. The comet is pretty bright, and its motion towards the west. Clouds have prevented any observation at Twickenham during the past night.

"A communication from Berlin this morning mentions —contrary to what I should yet have expected from my own calculations relating to the orbit—that Dr. Tietjen, of the Imperial Observatory, has found indications of a sensible deviation from parabolic motion in the recent bright comet between April 19 and July 14. The curve is *elliptical*, but the inferred period of revolution is of such length as to be open at present to uncertainty, which can only be removed by observations in the other hemisphere. The semi-axis major is found to be rather more than 430 times the earth's mean distance from the sun, and the corresponding length of revolution is nearly 9,000 years.

"The tail of the late comet increased very quickly and considerably in length, as frequently happens soon after perihelion passage. Assuming it to have proceeded from the nucleus very nearly in the direction opposite to that of the sun, its actual length had increased from 4,000,000 miles on July 3 to 16,000,000 on the 13th, and on the 19th, the last night it was visible in this hemisphere, to something over 25,000,000 miles. The increase of apparent length in this interval was from 4 deg. to 43½ deg."

NOTES

THE Priestley Centenary is to be celebrated, not only at Birmingham, as we have before announced, but at Leeds, by two meetings, to be held in the hall of the Philosophical Society. The chair will be occupied at the two meetings by Dr. Clifford Allbutt and Mr. Sykes Ward, F.C.S., and addresses are to be given by the Rev. J. C. Odgers, who is to read a paper On the personal history of Priestley; Mr. T. Fairley, F.C.S., On the phlogiston theory; and Mr. S. Jefferson, F.C.S., On the discovery of oxygen.

DR. ACLAND, Regius Professor of Medicine in the University of Oxford, has been appointed president of the Medical Council, in succession to Dr. Paget, of Cambridge. We believe the appointment is a five-yearly one.

AT a general meeting of the Council of the Yorkshire College of Science, held last Friday, Dr. T. E. Thorpe was elected Professor of Chemistry. Dr. Thorpe has for the last four years had the direction of large classes in theoretical and practical chemistry at the Andersonian University, Glasgow. He is the author of "A Manual of Inorganic Chemistry" and "A Text Book of Quantitative Chemical Analysis," and has made many original contributions to chemical literature.

THE death is announced of Father Paul Rosa, the colleague of Father Secchi at the Roman Observatory.

THE Select Committee of the Legislative Assembly of New South Wales, which was appointed to inquire into the management of the Sydney Museum, has furnished its report, in which the appointment of a Curator, with complete charge of the property of the Museum, subject to the Minister of Public Instruction, is proposed; at the same time an extension of the building at present holding the collection is suggested.

MR. C. A. BOWDLER's apparatus for steering balloons was tested on Saturday last at Woolwich, in the presence of several officers of the scientific branches of the army. The balloon to which the apparatus was attached was the new large one, 80 ft. high, belonging to Mr. Coxwell, which was considered by Mr. Bowdler too large for the size of his machine. His apparatus is very simple, consisting of fans like the screw propeller of a ship, 3 ft. in diameter, and making 12 or 14 revolutions per second, worked by hand. When the balloon was exactly balanced the vertical fan caused it to rise and fall, but the horizontal fan was found to have no effect whatever in guiding the direction.

THE French National Assembly has adopted the proposal to award to M. Pasteur a pension of 12,000 francs, one half of which reverts to his wife should she survive him.

WE view with great pleasure the advance of the Birkbeck Institution within the last few years in its scientific department. Quite recently a scientific society has been established in connection therewith, the object of which is to inculcate and develop a taste for scientific pursuits among its members, by the reading of original papers upon scientific subjects and by debates, and particularly for the encouragement of the application of scientific principles to the arts and manufactures. In immediate connection with this society we find a Naturalists' Field Club, the aim of which is to organise excursions to the various districts possessing scientific interest, for the purpose of studying practically and under the direction of practical men, those sciences, such as geology, mineralogy, botany, &c., a real and sound knowledge of which can only be obtained by the actual study of Nature. We wish this new undertaking all possible success. As a proof of the high character of the work performed by this institution and the excellence of the instruction provided, we need only call attention to the fact that this year its students have been awarded one half of the total number of prizes offered for public competition by the Society of Arts at its annual examinations.

THE Royal Academy of Belgium proposes the following subjects for prizes to be awarded in 1875:—1. To examine and discuss, on the basis of new experiments, the perturbing causes which influence the determination of the electro-motive force and the interior resistance of an element of the electric pile; to find out the number of these two quantities for some of the principal piles. 2. To give an exposition of the knowledge attained on the relations of heat to the development of phanerogamous plants, particularly in reference to the periodic phenomena of vegetation; and, in this connection, to discuss the value of the dynamical influence of solar heat on the evolution of plants. 3. To make new researches on the embryonic development of the *Tunicata*. 4. To make new researches to establish the composition and mutual relations of albumenoid substances. 5. To describe the coal-system of the basin of Liége. A gold medal of the value of 1,000 francs is the prize in subjects 4 and 5: one of 600 francs for subjects 1, 2, and 3. The memoirs ought to reach the Secretary of the Academy before August 1, 1875. They must be written either in Latin, French, or Flemish.

THE destruction of vineyards by *Phylloxera*, which has lately so much engaged the attention of entomologists and botanists, was recently the subject of a bill in the French Assembly. Many prefects, on the plea of public welfare, have issued orders for the uprooting and burning of diseased plants, and opposing the introduction of foreign stocks; but to make this desperate course effectual, a special law putting the *Phylloxera* on a level with the rinderpest is necessary. M. Destreaux has submitted a bill to make this possible, and the Academy of Sciences gives it its support. Notwithstanding the investigations that have made, no reliable specific against *Phylloxera* seems to have been yet discovered. The bill before the Assembly is received as "urgent."

MR. NEWBIGGING, in his "Handbook for Gas Engineers and Managers," London, 1870, p. 159, gives a "Chronology of Gas Lighting." By this author's statement the first public exhibition of gas in London was in 1807, by Mr. Winsor, who lighted Pall Mall at that time. But Prof. B. Silliman, writing to the *American Gas Light Journal*, gives an extract from the elder Prof. Silliman's "Journal of Travels in England, Holland, and Scotland," containing a description of a public exhibition of illuminating gas from coal in July 1805, by "an ingenious apothecary" in Piccadilly, near Albany House. "The inflammable gas," the journal states, "is extricated simply by heating common fossil coal in a furnace, with a proper apparatus to prevent the escape of the gas, and to conduct it into a large vessel of water, which condenses the bituminous matter resembling tar, and several other products of the distillation that are foreign to the principal object. The gas, being thus washed and purified, is allowed to ascend through a main tube, and is then distributed by means of other tubes concealed in the structure of the room, and branching off in every desired direction, till, at last, they communicate with sconces along the walls, and with chandeliers depending from the roof, in such a manner that the gas issues in streams from orifices situated where the candles are commonly placed. Then it is set on fire, and forms very beautiful jets of flame, of great brilliancy; and from their being numerous, long, and pointed, and waving with every breath of air, they have an effect almost magical, and seem as if endowed with a kind of animation. The gas is sometimes made to escape in revolving jets, when it forms circles of flame—and, in short, there is no end to the variety of forms which ingenuity and fancy may give to this brilliant invention. The expense of the apparatus, and its liability to accidents, forms an obstacle of magnitude, and, on the whole, it is probable it will not be generally adopted." This is curious reading in 1874! Mr. Murdock had employed gas illumination in 1792, and gas was used in Paris in 1802. But London was in the dark until 1805.

DR. MELLICHAMP, of Bluffton, South Carolina, has been prosecuting researches on the pitchers of *Sarracenia variolaris* and the way in which insects are caught in them. The species abounds in this district, and even early in May many pitchers were developed. He has confirmed the presence of the sugary secretion within the rim. He finds that it bedews the throat all the way round the rim, and extends downwards from ¼ in. to ¾ in. Dr. Mellichamp also finds—and this is his most curious discovery—that this sweet secretion is continued externally in a line along the edge of the wing of the pitchers down to the petiole or to the ground, forming a honeyed trail or pathway up which some insects, and especially ants, travel to the more copious feeding ground above, whence they are precipitated into the well beneath. Ants are largely accumulated in these pitchers. As to the supposed intoxicating qualities of this secretion, Dr. Mellichamp was unable to find any evidence of it. On cutting off the summit of the pitchers and exposing them freely to flies in his house, he found that the insects which came to them, and fed upon the sweet matter with avidity, flew away after sipping their fill, to all appearance unharmed. On the other hand, he thinks that the watery liquid in which the insects are drowned and macerated possesses anæsthetic properties; that house-flies, after brief immersion in it, and when permitted to walk about in a thin layer of it, "were invariably killed—as at first supposed—or at any rate stupefied or paralysed in from half a minute to three or five minutes," but most of them would revive very gradually in the course of an hour or so.

IT is probable that a scheme for the establishment of another Medical School at Dacca, on the same footing as those of Calcutta and Patna, will shortly be sanctioned by Government.

THE success which has attended the ostrich-breeding farms in South Africa has induced some French gentlemen to endeavour to imitate the system in Algeria, and African birds have also been sent to La Plata and other countries in South America, where it is hoped they may take the place of the native birds, which are inferior in quality to the African ostrich. Generally speaking, the system on which ostrich farms are conducted is as follows. The birds kept for breeding purposes, about three years old, are placed in separate paddocks, in pairs, and their eggs are either hatched in the natural way or placed in incubators prepared for the purpose. By this means a larger proportion of eggs is hatched. The young birds are fed on grass, lucerne, and other vegetable matters, and are sheltered at night. Each pair of birds will produce about twenty chickens, which may be plucked when they are about eighteen months old, before which time the feathers are not of much value. The price of good ostrich feathers, wholesale, is about 40*l.* per pound weight. If the birds are well kept, and have plenty of exercise and food, their feathers are of good quality; but the plumage of wild birds is considered superior to that of inferior tame ones. The value of each year's plucking from the young birds is about 7*l.*, and of the birds themselves at six months old is 30*l.* to 35*l.* The breeding birds are worth 125*l.* per pair.

THE new screw steamship *Durham* sailed from Plymouth on Sunday, bound for Melbourne, having on board several members of the Imperial German Astronomical Expedition They carry with them a large number of instruments with which to observe from Port Ross, one of the Auckland Islands, the coming transit of Venus.

WE have received, reprinted from the excellent Indian ornithological journal *Stray Feathers*, a copy of a lengthy paper by Mr. V. Ball, on the Avifauna of the Chota Nagpur division of Bengal, which, besides giving an account of the birds found in the district, contains an instructive description of its geology, flora, and mammalian fauna, the author laying great stress, as is but too seldom done, on the interdependence between these mutually related phenomena.

THE tenacity of life of popular errors is well exhibited in the following extract from the *Californian Horticulturist*:— "The influence of forests in drawing moisture from the heavens may be seen from the experience of San Diego, California. Previous to 1863 there was yearly a rainy season, which made the soil nourishing and productive. In 1863 a destructive fire swept over the greater part of the country, destroying the forest and blackening the hills. Since then there has been no rainy season at San Diego." When will public writers learn that forests influence the climate by drawing water, not from the air, but from the soil?

AN addition is in preparation to the Colonial Floras published under the authority of our Colonial Government, in the form of a "Flora of Mauritius." It will be edited by Mr. J. G. Baker, assistant-curator to the Kew Herbarium.

PROF. SCHIMPER, of Strassburg, in a paper read before the Botanical Congress at Florence, claims to have discovered a fossil plant in "protogine," a rock hitherto considered of igneous origin, which occurs in the form of erratic blocks on the sides of Mont Blanc and in the plains of Piedmont. The specimen, which was collected by M. Sismonda, and is preserved in the Museum of the Turin University, has been identified by Prof. Schimper as *Annularia sphenophylloides*, a plant, perhaps aquatic, widely distributed in the coal-strata of Mont Blanc.

A DRAWING-ROOM meeting in aid of the Palestine Exploration Fund was held on the 24th inst. at the residence of the Duke of Westminster, Grosvenor House. Capt. Warren, before giving an account of his experiences, made an appeal to the meeting for increased support to carry on the work of exploration, which was at present flagging for want of funds. He urged the subscribers to the Fund to complete the work of surveying the country as soon as possible, as the land, being so fertile, was constantly being taken by the Greeks and other foreign cultivators of the soil for farming purposes. As a consequence, the old names of the towns and villages were fast disappearing, and the whole country was assuming a different aspect. This meeting was the first of a series that is to be held, information as to which can be obtained of the secretary at the office of the Fund, 9, Pall Mall East.

ACCORDING to the State geologist of Minnesota, the cretaceous lignite beds of Minnesota Valley are likely to afford valuable coal mines.

IN the report to the Admiralty of Capt. G. S. Nares, of H.M.S. *Challenger*, dated Melbourne, March 25, 1874, Capt. Nares, speaking of the temperature of the ocean, especially near the pack edge of the ice, says:—"At a short distance from the pack, the surface water rose to 32°, but at a depth of 40 fathoms we always found the temperature to be 29°; this continued to 300 fathoms, the depth in which most of the icebergs float, after which there is a stratum of slightly warmer water of 33° or 34°. As the thermometers had to pass through these two belts of water before reaching the bottom, the indices registered those temperatures, and it was impossible to obtain the exact temperature of the bottom whilst near the ice, but the observations made in lower latitudes show that it is about 31°. More exact results could not have been obtained even had Mr. Siemens' apparatus been on board." It seems to us that the difficulty mentioned is one which would certainly have been surmounted by Messrs. Negretti and Zambra's new recording thermometers, a description of which appeared in NATURE, vol. ix. p. 387; this being exactly one of the cases to which this instrument is peculiarly adapted. We believe the inventors and makers have greatly improved their thermometer since our description appeared, and no doubt means will be taken by the Admiralty to transmit one to the *Challenger*.

MR. PILLISCHER, optician and scientific instrument maker, of New Bond Street, W., has been decorated by the Emperor of Austria with the golden Cross and Crown of Merit, as are cognition of his Majesty's approval of the superior quality and precision of his scientific instruments shown at the late Vienna Exhibition.

THE following is a list of candidates successful in the competition for the Whitworth Scholarships (Science and Art Department), 1874:—William Martin, metal turner, Wolverton; Robert A. Sloan, engineer's apprentice, Birkenhead; William Sisson, engineer, Gateshead; Frederick Stubbs, engineer's apprentice, Derby; Thomas L. Daltry, draughtsman's apprentice, Newcastle-on-Tyne; Frederick H. Livens, engineer's apprentice, Gainsborough.

THE additions to the Zoological Society's Gardens during the past week include two Tigers (*Felis tigris*) from Calcutta; two Yellow-billed Sheathbills (*Chionis alba*) from the Southern Ocean, presented by Mr. H. Roberts; a Wanderoo Monkey (*Macacus silenus*) from the Malabar Coast, presented by Lieut. Vipan; a Rose-crested Cockatoo (*Cacatua moluccensis*) from the Moluccas, presented by Mr. John Elms; three Grey-breasted Parakeets (*Bolborhyncus monachus*) from Monte Video, presented by Mr. C. Purnchard; a King Vulture (*Gyparchus papa*) from Tropical America; a Red-backed Buzzard (*Buteo erythronotus*) from South America, purchased; a Philantomba Antelope (*Cephalophus maxwellii*) born in the Gardens.

ON SPECTRUM PHOTOGRAPHY*

II.

I NEXT come to a very beautiful reflex action of spectroscopy on photography; and now I must take you back to America. I am nearly certain that everyone in this room is perfectly familiar with the name of Rutherfurd in connection with celestial photography: if you will allow me I will point my reference to him by throwing on the screen one of his magnificent photographs of the moon, which he was good enough to give me some little time ago. Unfortunately, I am not able to throw on the screen a photograph of the solar spectrum which we owe to him, the most magnificent photograph—and I say it with the intensest envy—which I think it is possible to obtain. However, I have a copy of it on the wall, and it is well worth inspection. Rutherfurd, whose name is associated with that of Delarue in the matter of celestial photography, was not content with reflectors. He lives in the centre of New York, and I suppose New York is as bad as London for tarnishing everything that the smoke and atmosphere can get at; and he came to the conclusion that he must abstain from celestial photography altogether, or else make a lens—and a lens with Mr. Rutherfurd means something over 12 in. diameter—which should give him as perfect an image in New York with 15 in. of glass, as a perfect reflector of 15 in. aperture would give him as far away from a city as you please. Mr. Rutherfurd, who never minces matters, knowing that it was absolutely impossible to get such a lens as this from an optician, who of course neglects almost entirely the violet rays—the very rays which he wanted—in constructing an ordinary telescope, determined to make such an one himself. He thought about the matter, and he came to the conclusion that in any attempt to correct a lens of this magnitude for the chemical rays, the use of the spectroscope would be invaluable. He therefore had a large spectroscope made, in order to make a large telescope, and then we have just as distinct an improvement upon the instruments which we owe to the skill of those who first adopted the suggestion of Sir John Herschel and brought together the chemical and the visual rays, as the improvement we owe to Herschel was upon the instruments which dealt simply with the visible rays. Mr. Rutherfurd simply discards the visual rays, and brings together the chemical rays; the result of his work being a telescope through which it is impossible to see anything, but through which the minutest star, down I believe to the tenth magnitude, can be photographed with the most perfect sharpness. This is the instrument of the future, so far as stellar astronomy is concerned. Having thus achieved what he wished in the construction of this instrument, and having the spectroscope, Mr. Rutherfurd commenced a research, which, I am sorry to say, he has never published, for it would be of the greatest value to any photographer or any astronomer amongst us, upon various kinds of collodion and upon the best arrangement of lenses for photographing the spectrum. Mr. Rutherfurd found that some collodions which he got were so local in their action as to be almost useless for that reason, and that others were so general in their action that they were also almost useless for the exactly opposite reason. I will now throw on the screen the line G and the lines in the green, or rather the lines approaching to the green near F; with ordinary collodions, such as one generally gets, that is to say, collodions not absolutely good, but free from both the extremes referred to by Mr. Rutherfurd, we want something like five seconds for the part near the line G. Well, when you go a little way along the spectrum in the less refrangible direction, you have to put minutes for seconds—in other words, the exposure has to be sixty times as long. I have another photograph of the spectrum, which will show you the part of the spectrum less refrangible than the line F to which I have referred. This photograph which you see on the screen required an exposure of very nearly half an hour.

Those of you who are most familiar with the solar spectrum will recognise the extreme importance of Mr. Rutherfurd's contribution to photographic spectroscopy, when I tell you that his photograph of the solar spectrum is quite as admirable and excellent as is the photograph of the moon which I have just shown you on the screen. During the last year this question of the solar spectrum has again been considerably advanced by photography in America. Mr. Rutherfurd's photographs, admirable although they are, are refraction photographs, that is to say prisms were used, and, more than this, prisms of glass. You will, therefore, quite understand that the photograph extends only a very little distance beyond the lines H. But America was not satisfied with this, and in the person of Dr. Draper, the son of the Professor Draper whose name is so honourably associated with the commencement of work done in photography thirty years ago, has just now photographed the solar spectrum far beyond H. A copy of his photograph is on the wall, but unfortunately I have not a copy which I can throw on the screen.

---

* Continued from p. 112.

I have already referred to the extreme importance of photography in astronomy, and the point that I wish to urge to-night, after what I have stated regarding all the work which has been done up to the present time, is this—That what photography has been in the past to astronomy—what it will be in the future no one can say—such can photography, and such must photography, be to chemists and physicists. Of course, in the way of photographic application, it is scarcely fair to say that a daily photographic record of the prominences around the sun is a question either of physics or of chemistry. But still the method which enables us, or which, I hope, will enable us shortly, to obtain a daily photograph of every prominence which bursts out—although absolutely invisible to our eyes—on the sun, is a method which depends on physical laws, and has nothing to do with astronomy in the ordinary sense. If you will allow me, I will show you now on the screen a photograph of a drawing which was made by an eminent Italian observer in India during the last eclipse. It is a drawing made by Prof. Respighi, of the sun's corona, as seen by the spectroscope; and I hope in the next eclipse we shall not any longer have merely drawings to refer to, but that we shall have a photograph which can be brought here, and which will let us know exactly how the matter stood. You see there on the screen three rings—a red ring, a green ring, and a blue ring. They are red, green, and blue, because the element in that part of the sun's atmosphere—hydrogen—gives us lines in the red, green, and blue; and they are rings because the hydrogen atmosphere extends in the most admirably regular way all round the sun. In fact, we may say that, in observations of this kind, we use the corona instead of the slit, and if that is good for the corona it is perfectly obvious to you it is good for the chromosphere—for the brighter regions lying closer to the sun than the corona does—as we know that it gives a line of intense blue, exactly where photography, as it is generally carried on, has its strongest *point d'appui* in the spectrum; and it is quite clear to you that we ought to be able to get a photograph of this every day, just as easily as we saw it in India during the eclipse.

We will next consider the application of photography, no longer to the mere solar spectrum, but to the physics of the sun. What is the solar spectrum? It is the continuous spectrum of the sun, minus certain portions where the light of the continuous spectrum has been absorbed. What have been the absorbers? The gases and vapours, generally speaking, in an excessively limited zone of the sun's atmosphere, lying close to the bright sun we see; close, I say, to the photosphere. This zone is called the reversing layer. Then if the solar spectrum is the result of the absorption of this reversing layer, what will happen to the solar spectrum if the constitution of the layer changes? Obviously a change in the solar spectrum. Now, recent researches carried on by means of photography show us that if you take any particular vapour in the reversing layer, which you may call A, for instance, and then assume that the quantity of A in the layer is reduced, the absorption of that particular vapour will be reduced; what then will be the result on the photograph of the solar spectrum? Some of the lines will disappear. Suppose that this particular vapour which we call A, instead of being assumed to decrease in quantity, increases in quantity, what will happen to the solar spectrum? The same researches have told us that as its quantity increases its absorption will increase, and that its increased absorption will be indicated by an increase in the number and in the breadth of the lines absorbed. What, then, will happen to the solar spectrum if any change of this kind is going on? The photograph of a solar spectrum taken, say, to-day, may be different from the photograph of the same part of the spectrum taken at some distant period. What is the distant period we do not yet know—whether three months, six months, six years, or eleven years; but, at all events, there is reason to think already that if we had a series of photographs of the solar spectrum, taken year by year, we should see great changes in the spectrum. Allow me to show you a photograph of a very limited portion of the solar question, and I will prove my case; and let me tell you I could not prove my case if photography had not been called in, because if the existence of any particular metal, or of the increase of any particular metal, depends on such a small matter as one line among 10,000, what will happen if a man neglects to observe this change? People will say, "Oh! in a research of that kind it is altogether excusable if he has made a mistake." But if you have a series of phenomena recorded by means of a camera on "a retina which never forgets," as Mr. Delarue has beautifully put it, and if you compare those pictures day by day, and year by year, the thing is put beyond all question when you get one line disappearing, or another line appearing.

Now we have before us a part of the solar spectrum near the line H, and I wish to call your particular attention to one line. We have admirable drawings of the solar spectrum taken about the year 1860. If the draughtsman was recording by means of his eye the lines in the spectrum, he would not be very likely to overlook a line darker than some he inserts, but he might easily overlook finer lines. Now, it is a fact that in the most careful map that we have—a map drawn with a most wonderful honesty and splendid skill—a line is absent, in the region indicated, which line is now darker than some that were then drawn, and that line indicates the presence of an additional element in the sun—strontium. I do not make this assertion thinking that subsequent facts will show the drawing to be wrong, but because I see reason to believe that what we know already of the sun teaches us that it is one of the most likely things in the world that strontium was not present in such great quantity in the reversing layer when the drawing was made; but, however that may be, I think you will see how important it is that this photograph, which I have just thrown on the screen, should be compared with photographs made five, ten, fifteen, a hundred, or two hundred, or as many years as you like ahead, and it is in this possible continuity of observation of the solar spectrum, carried on for centuries, that I do think we have in photography not only a tremendous ally of the spectroscope, but a part of the spectroscope itself. Spectroscopy, I think, has already arrived at such a point, at all events in connection with the heavenly bodies, that it is almost useless unless the record is a photographic one. I am glad to say that only to-day I have had a letter from Dr. Draper, who tells me he has at last succeeded in getting an admirable photograph of the spectrum of a star. Now that is of the very highest importance, because the sun is nothing but a star, and the stars are nothing but distant suns; and as long as we merely investigate the sun, however diligently or admirably we do it, and neglect all the others, it is as if a man who might have the whole realm of literature to work at should confine himself to one book, and that book probably not a good representative of the literature of the country he was examining into.

So much for the application of photography to what may be called the celestial side of spectroscopy; but let me tell you that this, so far as spectroscopy is concerned, does not exist. To the spectroscope all nature is one, and it is absolutely impossible to make a single observation, either on a sun, or a star, or a comet, without bringing chemical and physical considerations into play; and it will be a regrettable circumstance if chemists employ the spectroscope in terrestrial chemistry—they have not done much in that way yet—without taking the sun and all the various stars of heaven into counsel, because the spectroscope is absolutely regardless of space, and shows us that the elements which are most familiar to us here, or at all events a good many of them, are present in the most distant stars, and the spectroscope shows us those elements existing under conditions which are absolutely impossible here.

There is another point, too—spectroscopy is, above all things, molecular. We are dealing with the ultimate atoms, or molecules, or whatever you like to call them, when, by means of the spark, we drive a substance into vapour. And if chemists, for instance, will simply ask themselves which substances have their lines reversed in the solar spectrum, I think, before they have thought that problem out—that very simple problem, as it seems—there will be such a flood of light thrown upon terrestrial chemistry, that the only wonder will be that it has not been seen before, years and years ago. These, you will say, are theoretical applications. It is perfectly true; and there are a great many other theoretical applications that it would be my duty, as it would be my pleasure, to bring before you, if time permitted. But that is not all. I have to refer to the application of the spectroscope in what are considered by some people more practical directions. The more you deal with the most abstruse considerations of Science, the more likely you are to get practical applications out of them.

You have already seen how exceedingly important it was to use a slit instead of a round hole in these experiments. It was the verdict of Wollaston, and it was the verdict of Becquerel and Draper, as I have shown you to-night with regard to photography. You have also seen that we can use the circular corona as a slit equally well.

Now if we take a long slit and divide it into as many portions as we choose, we see at once the improvement that we introduce into spectroscopic photography. All we have to do is to divide that slit into portions, as it were, by letting a window run down the slit, and when the window has arrived at the second part of the slit, let in light from a new source. This principle has been carried out practically in the following manner:—A rectangular brass plate 71 mm. long, and 35 mm. broad, slides in grooves in front of the slit of the spectroscope, and a window 4 mm. high, cut out of this plate, leaves a portion of the slit of this length exposed. A small pin presses firmly against the face of one of the sliding plates, and a row of small shallow holes or notches is drilled in the plate so as to intercept it in its upward or downward movement at those points where the pin falls into a notch. The distance between the notches is precisely the same as the height of the opening cut in the sliding plate, so that the movement of this plate from one notch to another corresponds to a distance equal to the height of the exposed part of the slit, and the spectra compared are confronted, so to speak, absolutely; the upper edge of one spectrum abuts against the lower edge of the other, and the coincidence, or want of coincidence, between lines in the two spectra can thus be determined with the greatest precision. The spectroscope employed contains three prisms of 45° and one of 60°; its observing telescope is replaced by a camera with a 3-in. lens by Dallmeyer of about 23 in. focal length for the use of which I am indebted to Lord Lindsay. With this arrangement—the spectrum being received upon a sensitised ¼ plate—the portion between the wave-lengths, 3,900 and 4,500, can be obtained at once in good focus. A ray of sunlight, reflected from a heliostat mirror so as to fall upon the slit-plate, is brought to a focus by means of a double convex lens just between the carbon poles of an electric lamp, while a second convex lens placed between the lamp and the collimator tube, serves to cast an image of the sun or of the electric arc upon the slit-plate. Supposing, now, we wished to compare the iron spectrum with that of the sun: the sun's image in sharp focus on the slit-plate is first allowed to imprint its spectrum on the prepared plate. The ray of sunlight is then cut off, the sliding plate moved up or down till the pin catches in the next notch, and the image of the arc, passing between an upper pole of carbon and a lower pole consisting of a carbon crucible containing a fragment of iron, is allowed to fall on the portion of the slit thus exposed.

Let me show you some photographs illustrating this description. Here is a single photographic plate on which the new method has enabled us to register no less than four different spectra; those of you who are familiar with photographic processes will immediately see how it is that the number is not forty instead of four. Having a slit of a certain length, if I open all the length of that slit at once I should get a spectrum the breadth of which would depend upon the length of the slit; but if I commence operations by allowing the light first to come through one small portion of the slit, then we shall get the light from the particular metal which I employ in the electric arc falling on one part of the plate, and registering itself on the photographic plate. Then, if I close up that part of the slit, and open another one, I shall be able, through that newly opened part of the slit, all the rest being closed, to photograph on the plate the spectrum of another substance, say iron. Then, having used up that part of the plate, I can close that portion of the slit, I can bring my window lower down, and there we have the spectrum of cobalt. The window has been brought farther down, and there we have the spectrum of nickel, so that we have, as the work of some eight or nine minutes at the outside, a photograph—not a perfect one in this case, but this was the first one taken on this method—which will register with the most absolute and complete accuracy and certainty not less than 1,000 lines. Now a careful student of those lines, working as hard as he can, thinks himself very fortunate if he can lay down ten an hour. Therefore, as ten an hour are to 1,000 in seven minutes, so is the eye to photography in these matters.

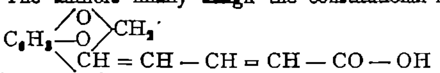
I have a photograph of a somewhat similar nature, which I am anxious to place before you. We have here an absolute comparison rendered possible, by means of photography, between the lines of the spectrum of iron and the lines of the spectrum of the sun. You see that in the case of most of the thick lines, you get a thick line in the solar spectrum corresponding with the lines of the iron. And, more than this, you see, I hope, all of you, that these lines of iron are of different lengths. The reason of that is that I have been careful to photograph on the plate the lines due to the various strata of iron vapour, from the rarest vapour, which is obtained at the outside of the electric arc, to the densest, which occupies the centre of the core, and you will see the most beautiful gradation as we pass from the outside part of the spectrum to the inside. This inside part represents the complete spectrum of the core, and the outside the incomplete and almost mono-chromatic spectrum of the vapour which surrounds the denser core in the middle of the spark; thus we have practically reduced the spectrum of iron to one line, instead of 460. That is the first photograph of the kind which has been taken; I say that, not because I am proud of it, but because you all know how enormously photographic processes are likely to be developed the moment, not one individual, but a great many, try their hands upon them, so that an enormous improvement upon what you now see may be anticipated. Not only have we developed, in the application of photography to spectroscopy, a valuable ally to Science, as we have in the application of photography to astronomy—and you know what that has done, and what it is going to do—but we have, I believe, what we may almost call a new chemistry, some day to be revealed to us by means of photographic records of the behaviour of molecules. Recollect that the difference between the iron spectrum of one line and the iron spectrum of between 400 and 500 lines is simply due to the difference in the arrangements of the molecules or atoms of iron in the centre of the electric arc and its exterior. There is one question which all lovers of the spectroscope may ask of photographers, and that is this, why should we any longer be confined, in registering spectra, to the more refrangible end of the spectrum, when one of the very first spectra of the sun that was ever taken was a complete photograph of the spectrum, including not only the blue, the green, and the yellow, but the red, and the extreme red? I think that if photographers will study the action of light on molecules, and read that extraordinary paper of Becquerel's, and will give those who are familiar with the spectroscope, and those who are anxious to promote the progress of spectroscopic research, a means of extending photographic registration, not only into the green part of the spectrum, which they do already with difficulty, but to the extreme red, then the use of the eye will almost entirely be abolished in these inquiries. And although no one has a higher estimate than myself of the extreme importance of the eye, I think that the more it is replaced by permanent natural records in these inquiries, the better it will be for the progress of Science.

J. NORMAN LOCKYER

SCIENTIFIC SERIALS

THE current number of the *Quarterly Journal of Microscopic Science* contains several papers of interest. Dr. Michael Foster commences with an article On the term Endothelium, in which he proves that the word is etymologically pure nonsense, Ruysch's word epithelium signifying that it covers papillæ. His endothelium must be understood to mean *that it is inside a papilla*. It is also valueless for other reasons: for if it is defined as that epithelium developed from the germinal mesoblast, the epithelium of the Wolffian ducts, of the ureters, and of Muller's ducts would have to be included. Therefore the term is insignificant and must be abolished. *Monoderic* and *polyderic* are proposed as terms to indicate that the cells form one or several layers.—The second part of Prof. Haeckel's interesting Gastræa theory follows, in English. In it the systematic and the phylogenetic signification of the Gastræa theory and the ontogenetic succession of the system of organs are discussed, as well as the bearing of the whole on the theory of types. The author is so prolific in his introduction of new words, the definitions of many of which are to be found in other publications, that a Haeckel Glossary in the next number of the *Journal* would not be out of place, to assist readers in the full appreciation of that illustrious biologist's very suggestive theory.—Mr. J. W. Groves explains his method of arranging and cataloguing microscopic specimens.—A paper follows by Mr. E. C. Baber On picro-carminate of ammonia as a microscopic staining fluid, in which he explains M. Ranvier's method. The great advantage of this reagent is shown to consist in its staining tissues in a series of colours varying from red to yellow; it also acts rapidly and can be kept in a dry form.—The Rev. E. O'Meara describes a collection of Diatomaceæ from Spitzbergen, including many species not enumerated by Cleve's Diatoms of the Arctic Sea.—Mr. Buck describes and figures a new Polyzoon belonging to the family *Halcyonelea*, named by him *Clavopora hystricis*, from a single specimen obtained in the expedition of the *Porcupine* in the Mediterranean.—An article from the *Indian Medical Gazette*, On the etiology of Madura foot, is discussed, the vegetable origin of that disease being severely handled. A note by the Rev. M. J. Berkeley is appended, strongly supporting Dr. V. Carter's original observations.—Dr. W. G. Farlow, of Harvard University, writes On a sexual growth from the prothallus of *Pteris cretica*, in which he shows that whilst in some of the prothalli archegonia and antheridia were developed, others gave rise to young fern-plantlets by a direct budding of the cells, without any sexual intervention. The paper is illustrated with two plates.—Mr. E. R. Lankester has two papers, one on *Torquatella typica*, a new type of Infusoria, allied to the Ciliata, from Naples; peculiar in not possessing cilia, not even round the oral region and capitular prominence, but in their place a bell-like prolongation of the body-wall like a ring of united cilia. The second paper is on the heart of *Appendicularia furcata*, in which that organ is shown to consist of two nucleated cells connected by fourteen or so slender vibratile fibrillæ, whose mutual connection by a membrane is uncertain. This organ is thus nothing more than a "most vigorous churn, beating and stirring up the fluid in the great perivisceral hæmolymph space without propelling it in any particular direction." The paper ends with some suggestive remarks on the reduction of the structure of organs in diminutive elaborate types generally.

Justus Liebig's Annalen der Chemie und Pharmacie.—Band 172, Heft 2.—The following papers are published in this part:—On the salts of parabanic acid, by N. Menshutkin. The formula of the ammonium salt is $C_3H_2N_2O_3\ NH_3$; by the action of water on the salt the ammonium salt of oxaluric acid is produced, and by the action of heat alone oxaluramide. The potassium and sodium salts have likewise been examined and two silver salts obtained, of which the formulæ are $C_3HAgN_2O_3.H_2O$ and $C_3Ag_2N_2O_3.H_2O$.—The same author contributes a paper entitled, "Notice on potassium oxalurate and the determination of the alkaline metals in the salts of the acids belonging to the uric acid group."—On the oxidation products of colophony and oil of turpentine, by Dr. Josef Schreder. By digesting colophony with dilute sulphuric acid, isophthalic acid ($C_8H_6O_4$) and trimellithic acid ($C_9H_6O_6$) are obtained. Turpentine oil oxidised by dilute nitric acid, gives terebinic and terephthalic acids.—On the conversion of cinchonidine into an oxy-base, by Dr. J. Skalivert. Cinchonidine is mixed with carbon disulphide and bromine dropped into the mixture. A brominated compound of the formula $C_{20}H_{22}Br_2N_2O$ is thus obtained, which on treatment with potassium hydrate yields the new oxy-base $C_{20}H_{24}N_2O_2$. Analyses of the sulphate and of the double Pt salt are given.—On ferrous anhydrosulphate, by T. Bolas, already noticed in the Journal of the Chemical Society.—The following are communications from the Tubingen laboratory:—(1) On the cyan- and carboxyl derivatives of diphenyl, by Oscar Doebner.—(2) On normal phenyl propyl alcohol and allylbenzene, by Leopold Rugheimer.—(3) Researches on the synthesis of allylbenzene, by Rudolf Fittig.—(4) Researches on the constitution of piperine and its decomposition products piperic acid and piperidine, by R. Fittig and W. H. Mielck. This is the fourth notice on the subject, and the authors now touch upon the constitution of piperic acid. By the action of bromine a tetra-brominated acid $C_{12}H_{10}Br_4O_4$ is obtained which by the action of sodium carbonate is converted into the dibrominated compound $C_{12}H_8Br_2O_4$. This last substance boiled with soda solution and precipitated by an acid yields a monobrominated body of the formula $C_{12}H_8BrO_5$. The authors next proceed to the consideration of a new acid which they have obtained by acting upon monobrompiperonal with bases, and then decomposing the salt produced by means of hydrochloric acid. The new acid has the formula $C_{13}H_{10}Br_4O_5$, and must be regarded as the substitution product of the acid $C_{12}H_{14}O_6$. By the action of soda on the sodium salt of the new acid an intermediate compound having the formula $C_{12}H_8Br_2O_5$ has been produced. Bromine dropped into a solution of hydropiperic acid in carbon disulphide, gives rise to the formation of the compound $C_{12}H_{12}Br_2O_4$. In the concluding section the decomposition of hydropiperic acid by means of fused potassium hydrate is treated of. The chief product of the reaction is protocatechuic acid, $C_7H_6O_4$, H_2O. The authors finally assign the constitutional formula



$$C_6H_3\begin{cases} \begin{matrix} -O \\ -O \end{matrix} \Big\rangle CH_2 \\ CH = CH - CH = CH - CO - OH \end{cases}$$

to piperic acid.—The part concludes with papers by Peter Greiss On the sulphurisation of sulphurobenzoic acid or dicarboxylsulphocarbanilide, and by M. G. Gustavson On tetra-iodide of carbon. This substance has been obtained by the action of aluminic iodide on CCl_4 according to the equation—

$$3CCl_4 + 2Al_2I_6 = 2Al_2Cl_6 + 3CI_4.$$

The substances are made to react in carbon disulphide solutions.

Gazzetta Chimica Italiana, Fascicolo V., 1874. This part contains the following papers:—On the extraction of sulphur, by F. Sestini.—On the action of sulphur on earthy carbonates, particularly on neutral calcium carbonate, with regard to geology and agriculture, by Prof. Egidio Pollacci. This paper was communicated in April to the Reale Istituto Lombardo di Scienze e Lettere. The author's principal object is to prove that a mixture of sulphur and calcium carbonate acted upon by water with free access of air gives rise to the formation of calcium sulphate. The chemical changes are thus expressed—

$$2S + 3O_2 + 2H_2O = 2H_2SO_4$$
$$2H_2SO_4 + 2CaCO_3 = 2CaSO_4 + 2CO_2 + 2H_2O.$$

The author is of opinion that the oxidation of the sulphur is effected *directly* by atmospheric oxygen in presence of $CaCO_3$ and water.—The concluding paper is entitled Chemical Research on Turkey Red, by Prof. Abelardo Romegialli. The remainder of the part is devoted to abstracts from foreign periodicals.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, July 1.—This number contains an article by Dr. J. Hann On the diminution of atmospheric vapour with increase of elevation. Experiment and mathematical theory both deny the existence of an independent vapour atmosphere, which according to Dalton's law would decrease much less rapidly with elevation than atmospheric vapour really does. Hence Mr. Strachey (Proceedings of the Royal Society, March 1861) would not deduct the vapour pressure from the height of the barometer to obtain the pressure of dry air. From a table showing the actual decrease of vapour tension with increase of height, observed in various ascents of mountains and in balloons, is derived a formula to express this decrease. Thus where p and p_0 stand for the pressures at the height h and at the surface of the earth, h being measured in units of 1,000 English feet,

$$(1)\ p = p_0\,(1 - 0{\cdot}075\,h + 0{\cdot}00146h^2)$$

and where e is the bases of natural logarithms, and h in units of 1,000 metres,

$$(2)\ p = p_0\,10 - \frac{h}{6517} = p_0 e - \frac{h}{2830}$$

If atmospheric vapour obeyed the law of Dalton, its weight over any place would be four and a half times greater than the real weight. Dr. Hann calculates the weight of vapour at 1,962 metres to be only half, at 6,500 metres one-tenth, of the weight at the surface of the earth. With respect to this rapid decrease of moisture, Strachey remarked that mountain chains, even of moderate altitude, must have great influence upon the hygrometric state of the atmosphere. The above formula can only be used safely for calculating the *mean* pressure of vapour at a given height. It may be useful for barometric measurements of altitudes, since it frequently happens that the vapour pressure of only one of two stations, of which the difference in height is required, is known. Observed values, up to 1,884 metres, have been actually found to agree well with those calculated by the formula. This formula may be only another expression for the opinion of Strachey, that the mean degree of saturation at different heights remains nearly uniform, and therefore the vapour tension depends merely on decrease of temperature. But the calculation of the mean vapour pressure of one level from that of another level with so great accuracy appears not to have been hitherto accomplished.

Annali di Chimica applicata alla Medicina, t. lviii., No. 5.—In dietetics there is a paper by Dr. F. Turbacco On cheese and its alimentary use.—Beaumertz furnishes a contribution on farinaceous substances as food for children.—In pathology there is a paper by Dr. L. Ledeganck (translated from *La Presse Médicale Belge*) On the action of parasitic organisms in the production of necrosis.—In therapeutics we have the following papers:—On the anæsthesia produced in man by the injection of chloral into the veins, by Oré.—Under the heading "Varieties" there is a paper by Prof. Fausto Sestini On the chemical composition of mulberry leaves; one On a new method of extracting logwood for vines and inks, from the agricultural chemical laboratory of Bologna, directed by Prof. A. Casali and Francesco Marconi; and, finally, a contribution by Melsens On the use of solutions of sulphurous acid, of neutral acid and sulphites, and of hyposulphites.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 11.—Researches in Spectrum Analysis in connection with the spectrum of the sun.—No. IV., by J. Norman Lockyer, F.R.S.

Maps of the spectra of calcium, barium, and strontium have been constructed from photographs taken by the method described in a former communication (the third of this series). The maps comprise the portion of the spectrum extending from wave-length 3900 to wave-length 4509, and are laid before the Society as a specimen of the results obtainable by the photographic method, in the hope of securing the co-operation of other observers. The method of mapping is described in detail, and tables of wave-lengths accompany the maps. The wave-lengths assigned to the new lines must be considered only as approximations to the truth. Many of the coincidences between lines in distinct spectra recorded by former observers have been shown by the photographic method to be caused by the presence of one substance as an impurity in the other; but a certain number of coincidences still remain undetermined. The question of the reversal of the new lines in the solar spectrum is reserved till better photographs can be obtained.

Royal Horticultural Society, July 1.—Scientific Committee. Dr. Hooker, P.R.S., in the chair.—Dr. Gilbert described the results of some investigations made by Mr. Lawes and himself on the conditions of the development of fairy rings. The mycelium of the fungus which produced the rings accumulated nitrogen in the superficial layers of the soil with the result of stimulating the growth of the grass and giving it the dark green colour which is characteristic of vegetation richly supplied with nitrogenous nutriment. When this luxuriant growth was grazed off, the soil was left relatively poor in nitrogen, and it was accordingly found that the superficial soil inside the rings was poorer in nitrogen than that outside it.—Dr. Hooker stated that seeds of the Kerguelen's Island cabbage (*Pringlea antiscorbutica*) sent to Edinburgh in a sealed bottle had germinated, while those sent to Kew in boxes had altogether failed. The following communication from Mr. Darwin was read:—"The leaves of *Pinguicula vulgaris* possess a power of digesting animal matter similar to that shown by the sundews (*Drosera*). Albumen, fibrin, meat or cartilage induce a secretion from the glands of the upper surface of the leaf, and their secretion becomes feebly acid (but not so much so as that of *Drosera*). Their secretion is reabsorbed, and causes an aggregation of the protoplasm in the cells of the glands, such as had been observed in other similar cases. Before excitement the glands were seen to be filled with a homogeneous pale greenish fluid; after the aggregation of the protoplasm it can be seen to move. When a row of insects or of cabbage seeds are placed near the margin of a leaf (or when a single insect is placed at one point), the whole margin (or one point) becomes curled considerably over in two or three hours; the apex of the leaf will not turn over towards the base. Small fragments of glass also cause a similar movement, but to a much less degree. The inflexed margin pours forth a secretion which envelops the flies or seeds, but pieces of glass cause no, or hardly any, increase of secretion. But here comes a puzzle: if the flies or fly be removed, the margin of the leaf turns back in less than twenty-four hours; but it does so also when a row of flies and cabbage seeds are left adhering; so that the use or meaning of the inflexion is at present quite a puzzle."—Mr. W. G. Smith showed engraved wood blocks of lignum vitæ, which he found more brittle than box.

VIENNA

Imperial Academy of Sciences, Feb. 26.—Dr. Urba communicated a paper on some rocks of South Greenland, collected by Prof. Laube, from the second German Polar Expedition.—M. Pelz presented a memoir on determination of the axes of conical surfaces of the second order.—Dr. Adolph Meyer gave an account of new and little-known birds of New Guinea.—Dr. Exner read a paper on the employment of the ice-calorimeter for determining the intensity of the solar radiation; describing an apparatus by which the intensity may be measured directly in calorics, without (as in the Pouillet pyrheliometer) a change of temperature in the instrument, rendering correction necessary.—Dr. Brauer communicated a note on the development and mode of life of *Lepidurus productus* Bosc.—MM. Schulhof and Holetschek communicated the elements and ephemerides of a comet discovered on Feb. 20 by Prof. Winnecke at Strassburg.

PARIS

Academy of Sciences, July 20.—M. Bertrand in the chair.—The following papers were read:—Note on the action of two current elements, by M. Bertrand. The assertion that two elements of the same direction attract one another is shown to be inexact, even for parallel elements, and does not agree even with Ampère's law. The author has solved the following problem:—A current element being given, to find in a point of space M the direction that must be assigned to another element, that their mutual action may be attractive, repulsive, or *nil*.—Extract from the Report of the Commission of the Agricultural Society of Chalon-sur-Saône, in the department of Saône-et-Loire, on Phylloxera, by M. Boully.—Reply to a criticism by M. Garrigou, contained in a recent note entitled "Carboniferous Limestone of the Pyrenees; Marbles of Saint-Béat and of Mont," by M. A. Leymerie.—On the efficacy of the method of submersion as a means of improving the vine in the Crimea: extract from a letter from M. Boutin to M. Dumas.—Employment of the *résidus d'enfer* of the oil-mills against *Phylloxera*, by M. Rousseau.—Third note on the electric conductivity of ligneous bodies, by M. Th. du Moncel.—On the stratification of the electric light, by M. Neyreneuf.—On the passivity of iron, by M. A. Renard. The author described several experiments illustrative of methods by which iron can be made passive in ordinary nitric acid.—Action of chloroform on sodic acetatic ether, by MM. A. Oppenheim and S. Pfaff.—The product of the reaction was saponified by soda and then acidulated with HCl. A new acid of the formula $C_9H_8O_4$ is thus obtained. This acid is dibasic and belongs to the aromatic series, the authors considering it an isomer of uvitic acid, the substituted groups occupying the positions 1 : 2 : 4.—On the isomeric compounds C_2H_4IBr, by M. C. Friedel. The author has repeated the experiments recently published on this subject by M. Lagermarck, and concludes therefrom that no third isomer of this formula exists.—On a development of heat produced by the contact of sodium sulphate with water at temperatures when the known hydrates of sodium sulphate cannot exist, and when the saturated solution of the salt deposits it only in the anhydrous state, by M. de Coppet.—Ethers of normal propylglycol, by M. E. Reboul.—Experiments on the generation of proto-organisms in media protected from aërial germs, by M. Onimus.—Indifference in the direction of the adventitious roots of a cactus, by M. D. Clos.—Observation of a bolide on the evening of July 18, at Versailles, by M. Martin de Brettes.—On the composition of potassium permanganate, by M. E. J. Maumené. The author concludes that the formula of the salt is Mn_2O_7KO.—New method of determining metals or oxides, by the same author.

CONTENTS

PAGE
JOSEPH PRIESTLEY 239
ON TESTIMONIALISM 241
THE RAINFALL OF BARBADOS. By the Hon. F. A. R. RUSSELL . . 241
OUR BOOK SHELF 242
LETTERS TO THE EDITOR:—
  Early Contributions to Spectrum Photography and Photo-chemistry.—Prof. J. W. DRAPER 243
  Sounding and Sensitive Flames.—Prof. W. F. BARRETT 244
  Aid to Private Research—Circulation of Scientific Memoirs.—H. W. LLOYD TANNER 244
  Photographic Irradiation.—W. C. CROFTS 245
  Feathering in Flint Weapons.—Dr. LAWSON TAIT 245
LOCALISATION OF FUNCTIONS IN THE BRAIN.—Dr. J. BURDON-SANDERSON, F.R.S. 245
THE FORM OF COMETS. By M. FAYE (*With Illustrations*) . . . 245
REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL," VI. (*With Illustrations*) 249
THE STRICKLAND CURATORSHIP IN THE UNIVERSITY OF CAMBRIDGE . 250
A NEW ORDER OF HYDROZOA. By Prof. G. J. ALLMAN, F.R.S. . . 251
ANOTHER NEW COMET. By J. R. HIND, F.R.S. 252
NOTES 252
ON SPECTRUM PHOTOGRAPHY, II. By J. NORMAN LOCKYER, F.R.S. 254
SCIENTIFIC SERIALS 256
SOCIETIES AND ACADEMIES 258

THURSDAY, AUGUST 6, 1874

HITZIG *v.* FERRIER.

IN a German contemporary, *Das Ausland*, for July 6, the editor has a note on the comparative value of the researches of Drs. Hitzig and Ferrier, in which he animadverts severely on English journals, specially mentioning NATURE, because they have not taken up the subject, and shown that all the credit of the discovery of the localisation of the cerebral functions is due to Fritsch and Hitzig, and that Ferrier has only followed up their line of investigation without giving them due credit for their work.

It is evident that the editor of *Das Ausland* is not a constant reader of this journal, for if he were he would not have stated that we have taken no notice of the work of Fritsch and Hitzig. We believe that we were the first, or, if not the very first, among the first in this country to draw attention to the researches of the able German physiologists, when we gave an abstract (NATURE, vol. viii. p. 467) of an excellent report by Dr. Neftel in Dr. Brown-Séquard's Archives of Scientific and Practical Medicine (New York), upon some of the recent researches in Neuropathology, including an account of the investigations of Fritsch and Hitzig, Gudden, Nothnagel, and others Our object in publishing that abstract was to enable our readers to form their own opinion on the subject.

The facts, as far as they affect the question at issue, are these:—It had until quite recently been thought that the cortical substance of the cerebral hemispheres was devoid of irritability, being the seat of mental phenomena. Hitzig in 1870[*] found that contraction of the eye-muscles in man can be produced by galvanic excitation of the hemispheres. This discovery led Hitzig, and with him Fritsch, to commence a series of investigations on the lower animals, with very feeble galvanic currents; and as the results of their experiments they were able to state that the excitation of distinct and limited portions of the anterior convex portion of the brain produces movements of certain groups of muscles on the opposite side of the body, the following new facts being established.[†]

1. The indication of the points for the irritation o almost all the muscles.
2. The proof that after the irritation with the induced current, secondary movements appear.
3. The proof that epileptiform fits may follow the application of this current.
4. The proof that the loss of blood destroys the excitability of the brain.

In the "West Riding Lunatic Asylum Medical Reports for 1873" (vol. iii.), Dr. Ferrier published a paper containing the results of experiments on various animals, in which the cerebral surface was excited by the interrupted current. This physiologist also localises the seat for the stimulation of different sets of muscles, in many cases going more into detail than do Fritsch and Hitzig; the method of stimulation which he adopts—the interrupted current—being one which the German authors had rejected as unsuitable.

What Dr. Hitzig complains of is, that in the original paper above referred to Dr. Ferrier only mentions his name and that of Fritsch in connection with the first of the four above-stated propositions, thereby retaining for himself the whole credit for the other three. In a review of Hitzig's recent work, published in the *London Medical Record*, Dr. Ferrier—writing in a spirit which we hardly think suitable to the occasion, and regretting that he has not indicated some *minor* coincidences between his observations and those of Fritsch and Hitzig, "on account of the construction which Hitzig puts upon them"—acknowledges, we are glad to see, that there are several points which the two German physiologists recorded, and which he had previously failed to credit them with. Nevertheless, he still seems to fail to realise that his true relationship to the original discoverers of the method he employs is that of disciple to master, and not that of an equal, as far as the subject itself is concerned.

To show that due credit has not been given in the right direction, it may be mentioned that in this country the localisation of the cerebral functions has thus become associated with the name of Dr. Ferrier, so much so that in his recent work on "Mental Physiology," Dr. Carpenter, in an appendix, has a chapter on the subject, in which the names of Fritsch and of Hitzig are not even mentioned, the title being "Dr. Ferrier on the Brain." Now, Dr. Carpenter, in this chapter, gives a kind of abstract of Dr. Ferrier's paper above referred to, and it is impossible that an author of so much experience could have omitted even the mention of the true workers-out of the method and facts he recounts, unless these facts and methods had been brought before his notice in a manner which does but very insufficient justice to their originators.

The same cause has probably led most Englishmen to associate the name of Dr. Ferrier so intimately with the doctrine. The question is, Has this author given due credit to Hitzig and to Fritsch, whose careful series of experiments—called into existence by the logical working-out of an opportunity which many less competent observers would have let pass unheeded—gives them full reason to expect all the honour due to the discoverers of the localisation of the cerebral functions?

Dr. Ferrier may remark that the work of Fritsch and Hitzig was public property for three years before he published his investigations, and that in his paper he assumes that the reader was acquainted with the foreign literature on the subject. Other physiologists have acted on that assumption, and have received credit for a depth of thought and power of observation which they have not deserved; and this experience should make all authors more than ordinarily careful, when continuing the investigations of other than their own countrymen, to state clearly and fully all that has been previously done by foreigners in their particular line.

Dr. Hitzig seems much aggrieved at the little credit given him by Englishmen in comparison with that which has been bestowed on Dr. Ferrier; but he may rest assured that all working physiologists fully appreciate the value of his methods and his facts, and that their conviction that his position is impregnable is the only reason why they have not thought it necessary publicly to state in print what time will prove to all, namely, that he was the undoubted discoverer of the important doctrine with which his name is so intimately associated.

---

[*] Du Bois-Reymond's *Archiv*.

[†] See *London Medical Record*, vol ii., p 448.

A MARINE AQUARIUM FOR INLAND STUDENTS

A COMMITTEE of the British Association was last year appointed to make some inquiries into the best mode of preserving delicate marine organisms during life, the question being whether the injection of a fine stream of air into the tank in which they are living would be as efficient as, or better for this purpose than, a jet of running water. Dr. Hubrecht, of the Hague, has furnished Mr. Ray Lankester with the following account of a contrivance worked with great success by Prof. Selenka, who has recently given up his chair at Leyden, on account of malaria, and taken a similar post at Erlangen.

A point of the greatest importance for those who study marine animals and who want to keep them alive for a certain time, is the way to keep a limited supply of sea-water fresh and in good condition so as to sustain life in the objects of their researches. Even in those vast institutions on the coast at Brighton, Naples, &c., where the inhabitants of the ocean exhibit their splendours to the eyes of the public, and where there would seem to be no difficulty at all in changing and refreshing the sea-water at any given moment, this point requires more attention and care than is ordinarily supposed, and the success of an aquarium often depends upon the more or less ingenious method by which the refreshing of the water is brought about. Especially important is a free access of atmospheric air, which must enter into solution and sustain the respiration of the different inmates.

To attain this end on a small scale in a laboratory situated at a distance from the sea-coast, with glass vessels of various sizes instead of tanks, and a small barrel of sea-water, which must suffice for a considerable time, the following system, adopted by Prof. Selenka, first in Leyden and at present in Erlangen, gives the most satisfactory results.

A receptacle for fresh water of about 2 cubic ft. or larger is placed in some spare corner, two stories higher than the room in which the aquarium is situated. By means of a siphon reaching to the bottom, the water can be put into communication with a tube leading to the lower floor. A tap enables one to regulate the quantity of water flowing through the siphon. Immediately behind the bend of this and fastened to the side of the receptacle, a so-called Bunsen's aspirator effects the distribution of air-bubbles in the water streaming down. This instrument simply consists of a tube in glass or gutta percha, with an opening as large as a pin's head. The water now continues its way downward through a series of glass tubes of no great width, fastened to nails in the walls by strings.

This system of tubes, to be had at a very small cost and labour, leads the water into a second receptacle in the same room with the improvised aquaria. It consists of a cylinder in zinc of about three feet by one in diameter placed upon a wooden stool; a large tap at the bottom permits its being emptied into a pail. In the lid three small tubes form a communication with the exterior, each of them, as well as the whole apparatus, being closed by taps as hermetically as possible. One of these is put into communication with the above system of tubes which descend to the bottom of the receptacle. The second, to which no interior tube is fastened, is in communication with a pair of bellows which permit the creation of an initial atmospheric pressure in the reservoir. Instead of the bellows a simple tube, half india-rubber, half glass, may do as well, the pressure then being obtained by simple blowing with the mouth. The function of the above apparatus is clearly that of compressing the atmospheric air in the zinc receptacle by means of water descending from a certain height. This compressed air is now used for the refreshing and providing with oxygen of the sea-water in the different smaller vessels.

A third tap in the lid of the zinc reservoir permits the air to escape into a glass bell, where a small mercury manometer indicates the amount of pressure, a detail which may, however, be omitted. In the perforated stop of this bottle from six to twelve hermetically sealed glass tubes—shellac is best for sealing them, india-rubber for the stop itself—are ready to provide the different vessels with a supply of air. With this view india-rubber tubes, which can be shut up by glass staves, form the continuation of the glass ones. When made ready for use, a spring screw applied to this india-rubber tube, regulates the quantity of air flowing out, while a special end-piece conducting the air-bubbles into the vessel with sea-water is pushed into the open end of the tube.

Those end pieces form an important part of the apparatus and may give rise to a great economy of the force required, when by some well-adapted combination their effect is multiplied.

In order to obtain the greatest advantage from the air-bubble which, when the apparatus is put into working order, rises through the sea-water in the vessel into which one of the tubes is brought, it is desirable that it should present as large a surface as possible to the water; making the contact more perfect and the dissolving process easier.

A so-called vulcanised rose, with numerous fine pores, is for this purpose fixed to the extremity of the tube on the bottom of the vessel. This may be replaced by a simple india-rubber stop which has been applied to the extremity of the tube, and into which extremely fine glass tubes—easily got by pulling out a thicker one before the blowpipe and cutting it to the required lengths—have been inserted. Or we may take two flat circular pieces of vulcanised india-rubber connected together, and fix into the border of the lower one a series of such fine glass tubes disposed like the spikes of a wheel, care being at the same time taken that the communication be maintained between the hollow part of this india-rubber disc to which the hair tubes correspond and the glass tube providing the air.

To make the effect in the water still more complete, a small water wheel (the paddles of which are made of thin half-spheres of glass, the axis of a vulcanised tube revolving round a glass stave) may be placed above the rising stream of air-bubbles, which put the wheel in a slow rotation, and cause in this way a constant movement of the particles in the sea-water, a circumstance which cannot but be favourable.

Nearly the whole of the apparatus described above may be made at home, and can be had at very little cost. It is of great efficiency and keeps the sea-water in the smaller vessels in a wonderful condition of purity, if care be taken to remove dying specimens and if no feeding be going on. Development of eggs and larvæ may be studied without the necessity of changing the sea-water excepting at considerable intervals of time, and marine animals of the most varied types can be kept alive very long indeed at a very small expenditure.

If put into practice by any private zoologist or laboratory in Britain, the results will most probably be no less gratifying than they have been in the above-named places where the system has only as yet been carried out.

A little more costly but still more efficient is a zinc gasometer, which can contain about half a million cubic centimetres of air, with a diameter of about 60 centims. This may be placed as it is in Erlangen without difficulty in the corner of any laboratory. It is wound up every morning by means of a simple capstan, and the pressure is effected by stones put on the top. The quantity of air escaping can be accurately regulated by hermetic taps in the conducting tube.

The great advantage which it has in common with the apparatus described above is that it remains active without further interference for a space of twenty-four hours.

FOSTER'S "PHYSIOLOGY"

Physiology. (Science Primers). By M. Foster, M.A., M.D., F.R.S. (Macmillan and Co., 1874.)

IT is extremely seldom that a fairly informed reader can lay down any text-book, after having read it from end to end, and feel that it has completely fulfilled the purpose for which it was written. Either the method of explanation is imperfect and involved, the facts that are given being correctly stated, or the language may be excellent at the same time that there is a want of attention to accuracy. We believe, however, that all will agree with us in thinking that in this short "Science Primer" Dr. Michael Foster has succeeded in producing an introductory manual which is perfect in itself, and quite a type for future authors of similar productions.

Many who devote themselves to the higher branches of scientific inquiry seem to have an inborn fear of putting the arguments and facts of their favourite subject in any but the most uninteresting and unintelligible language. They write on the assumption that their readers are all as well informed, or nearly so, as themselves on the literature of the science of which they treat; consequently, to the majority their works are of comparatively little value. This imperfection is manifest in many text-books, the utility of which is thereby reduced below that of many otherwise less worthy productions to the commencing student.

In the work before us, however, we think that Dr. Foster has succeeded, beyond any author with which we are acquainted, in placing himself on a level with his intended readers, and in putting the fundamental principles of physiology before the commencing student in a language, and by means of a consecutive argument, which possesses quite sufficient intrinsic attraction to tempt anyone with the least predilection in that direction, to study, reason out, and attempt to verify his statements. Dr. Foster's similes are peculiarly to the point, and are at the same time drawn from such well-known sources, that no one will have the least difficulty in perceiving their applicability, at the same time that he will be able to realise the full importance of their bearing. The following is one of the best of these, and will well repay the reading:—

"When you look down upon a great city from a high place, as upon London from St. Paul's, you see stretched below you a network of streets, the meshes of which are filled with blocks of houses. You can watch the crowds of men and carts jostling through the streets, but the work within the houses is hidden from your view. Yet you know that, busy as seems the street, the turmoil and press which you see there are but tokens of the real business which is being carried on in the house. So it is with any piece of the body upon which you look through the microscope. You can watch the red blood jostling through the network of capillary streets. But each mesh bounded by red lines is filled with living flesh, is a block of tiny houses, built of muscle, or of skin, or of brain, as the case may be. You cannot see much going on there, however strong your microscope; yet that is where the chief work goes on. In the city the raw material is carried through the street to the factory, and the manufactured article may be brought out again into the street, but the din of the labour is within the factory gates. In the body the blood within the capillary is a stream of raw material about to be made muscle, or bone, or brain, and of stuff which, having been muscle, or bone, or brain, is no longer of any use, and is on its way to be cast out. The actual making of muscle, or of bone, or of brain, is carried on, and the work of each is done, outside the blood, in the little plots of tissue into which no red corpuscle comes."

Notwithstanding the simplification of the argument to its extreme degree, no attempt is made to arrive at this simplification at the expense of truth. We are not informed, as is often said, that venous blood contains carbonic anhydride dissolved in it, whilst in arterial blood this is replaced by oxygen; but more accurately, though less simply, that "both contain, dissolved in them, oxygen, nitrogen, and carbonic acid; venous blood contains less oxygen and more carbonic acid than arterial blood."

Some will think that many of the straightforward facts of the circulation should not be studied until they can be appreciated, unassisted, in their logical sequence; but we think that the following quotation will give a reality to the peregrinations of a blood-corpuscle which comes home to even very young minds. "Suppose you were a little red corpuscle, all by yourself, in the quite empty blood-vessels of a dead body, squeezed in the narrow pathway of a capillary, say of the biceps muscle of the arm, able to walk about, and anxious to explore the country in which you found yourself. There would be two ways in which you might go. Let us first imagine that you set out in the way which we will call backwards. Squeezing your way along the narrow passage of the capillary in which you had hardly room to move, you would at every few steps pass, on your right hand and on your left, the openings into other capillary channels as small as the one in which you were. Passing by these you would presently find the passage widening, you would have more room to move, and the more openings you passed the wider and higher would grow the tunnel in which you were groping your way. The walls of the tunnel would grow thicker at every step, and their thickness and stoutness would tell you that you were already in an artery, but the inside would be delightfully smooth. As you went on you would keep passing the openings into similar tunnels, but the further you went on the fewer they would be. Sometimes the tunnels into which these openings led would be smaller, sometimes bigger, sometimes of the same size as the one in which you were. Sometimes one would be so much bigger that it would seem absurd to say that it opened into your tunnel. On the contrary, it would appear to you that you were passing out of a narrow side passage into a great wide thoroughfare. I dare say you would notice that every time one passage opened into another the way suddenly grew wider, and then kept about the same size until it joined the next. Travelling onwards in this way you would, after a while, find yourself in a great wide tunnel, so big that you, poor little corpuscle, would seem quite lost in it. Had you anyone to ask, they would tell you that it was the main artery of the arm. Toiling onward through this, and passing a few, but, for the most part, large openings, you would suddenly tumble into a space so vast that at first you would hardly be able to realise that it was the tunnel of an artery like those in which you had been journeying. This you would learn to be the *aorta*, the great artery of all; and a little further on you would be in the heart."

In conclusion, we are sure that there is no book which could be more profitably placed in the hands of the youth of both sexes, as a means of intellectual training and general culture, than this small work of Dr. Foster's. It possesses the advantage of combining precise reasoning with information on a subject which is all-important in every-day life; a subject which, if more universally understood, would lead to the adoption, by all, of means for the healthy maintenance of life which are now as systematically ignored as they are misunderstood. The reader is referred to Prof. Huxley's "Elementary Physiology" for the discussion of many subjects which the space allowed and the age of the pupils make it necessary to omit in the work before us.

OUR BOOK SHELF

Exposition Géométrique des propriétés générales des Courbes. Par Charles Ruchonnet (de Lausanne). Troisième édition, augmentée et en partie refondue. (Paris, 1874.)

Eléments de Calcul approximatif. Par Charles Ruchonnet. Seconde édition augmentée. (Paris, 1874.)

WE have read these works with interest and somewhat of surprise; with interest because the subjects are fairly interesting and are treated in the well-marked style which distinguishes the writings of French mathematicians; with somewhat of surprise that the subjects treated at such length should have met with such a large circle of readers as is indicated by the number of editions that have been called for. The first work on our list establishes many general properties of curves by means of first principles and by the use of infinitesimals. This mode of treatment, so far as we know, is confined in our own text-books to a chapter or two in Dr. Salmon's works, and it would be hard to find more than he has given in any other work. The author himself states that this elementary knowledge will carry the student through the book with the sole exception that a more extended acquaintance with mathematics is required for an article devoted to the finding the distance between a curve and its osculating sphere in the neighbourhood of the point of contact. The author, too, claims the major part of the demonstrations as his own, though in some cases he has generalised results previously given, and in some cases has established known properties in a novel way.

The work is divided into two parts; the first treating of the tangency, curvature, and osculating circle of plane curves: the second part treats of the analogous properties for non-plane curves, and deals also with the polar surface, the osculating sphere, ruled surfaces, developables, and the osculating helix. There are five pages of plates containing eighty clearly drawn figures.

The "Calcul approximatif" is concerned with numbers only. M. Ruchonnet considers that he has improved upon the processes given by previous writers as regards their generality and precision as well as the facility with which they are effected. There are six articles and two notes. In the preliminary observations, the writer's aim is concisely stated to be the turning of an expression composed of incommensurable numbers (incommensurables avec l'unité) into a decimal to any given degree of exactness. He here treats of *absolute* and *relative* error, and then proceeds to summation. In the third article, in applying his methods to multiplication and involution, he sketches out the contracted process of multiplication employed by Oughtred; then follow contracted division (reference made to Serret's "Arithmétique"), evolution, and functions of a single variable. Amongst the important additions in this edition, is a complete solution of the problem "Combien de chiffres exacts faut-il calculer d'un nombre pour pouvoir en extraire la racine m$^{\text{ième}}$ avec *n* chiffres exacts?"

Many illustrative selections might be made, but as these would not be of general interest, we content ourselves with recommending those who take an interest in either of the subjects discussed by M. Ruchonnet to taste and judge for themselves.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Flight of Birds

IN NATURE, vol. x. p. 147, I observe a letter signed "J Guthrie," and dated from the Cape, on the subject of the Flight of Birds, and particularly on the "hovering" of birds. It appears that one of your correspondents had referred to my chapter on this subject in the "Reign of Law" as giving a satisfactory explanation of this phenomenon. Mr. Guthrie thinks, on the contrary, that what I have there said "requires no refutation;" which is not wonderful considering the entire misconception which he evinces of the explanation I have given. He quotes me as affirming that "by a proper arrangement of its wings and tail and the position of its body, a bird can, *without muscular exertion*, remain suspended in a horizontal air-current, provided the latter be of sufficient velocity." If I had said this I should have talked nonsense. But I have not said it, as your readers may see by referring to the page (170, first edition) to which Mr. Guthrie himself refers. What I have said is, that under certain conditions of strength of air-current a kestrel can maintain the hovering position "with no *visible* muscular motion whatever." Mr. Guthrie omits the word "visible," and probably has no idea of its force and meaning in the sentence referred to. The maintenance of the wings and tail in the proper position, and of the body at the proper angle, does in itself, of course, involve continuous and difficult muscular action, although it is not visible, just as a rope-dancer standing still in some tiptoe attitude may require immense muscular effort although no motion be visible, and although the whole aim, object, and effect of that exertion be to produce stillness, and not motion.

So far is it from being true that I have represented hovering as an accomplishment of wingmanship which requires little exertion, that I have asserted with emphasis the exactly opposite doctrine—that it is a specially difficult operation, requiring very often great exertion, and always requiring special muscular effort.

It is evident, however, that Mr. Guthrie is still ignorant of the facts which have to be explained. In the passage which he misquotes I am not stating any theory; I am stating a fact which I have seen over and over again. It is a fact beyond all question that a kestrel can maintain itself hovering in a strong horizontal air-current, with no other muscular exertion than that which is required to keep its wings and body at th right angle. I have seen it done a hundred times in level countries, when by no possibility could any upward deflection of the wind have arisen from the configuration of the ground.

One of the first and most fundamental facts to be admitted and accounted for in the flight of birds is, that perfectly horizontal air-currents have a powerfully sustaining effect upon vane surfaces, which are presented to them as birds' wings are presented. "Hovering" and "soaring" are only to be explained when this fact is seen and admitted. ARGYLL

Inverary, Argyllshire, July 30

Exhibition of Specimens and Apparatus at British Association Meetings

I AM anxious to draw the attention of the readers of NATURE to the arrangements to be made this year at the British Association meeting (for the first time) for the reception of specimens and apparatus illustrating papers or short communications made to the sections. The provision of a room for this purpose—a kind of temporary museum—has during the last four years been recommended by the committees of Sections C and D, several times, and this year the experiment is to be made. Those who have promoted this plan are naturally anxious that it should be a success. I would therefore appeal to the secretaries of the various sections to assist in initiating this new feature of the meeting, by endeavouring, as far as possible, to secure from the authors of papers objects which illustrate their communications; such objects to be deposited during the week of meeting in the room provided by the Council. This room will be open to inspection under the same regulations as the sectional meeting rooms, and the objects deposited will be carefully ticketed and arranged, and, where necessary, placed under glass cases.

From Section A we may expect physical and astronomical apparatus and models; from B, new chemical products and specimens of apparatus illustrating new processes, from C, geological specimens of rarity or new to science; from D, zoological and botanical specimens, anatomical preparations, for the exhibition of which microscopes will be provided, and also ethnological specimens; from E, maps and geographical models; from F and G, models or machinery not too large for a room.

It is necessary to mention that objects exhibited must be in illustration of some communication (however short) to one of the sections, in order that they may thus be sanctioned by the committee of such section.

By the co-operation of the sectional secretaries with the members of the committee appointed to superintend the arrangements of this room or repository, we ought to succeed in adding an important and valuable feature to the scientific interest of the meetings of the Association. E. RAY LANKESTER

A Waterspout at Milford Haven

THE enclosed account of a waterspout which was sent to me by one of our telegraphic reporters may perhaps be of interest to your readers. ROBERT H. SCOTT

Aug. 1

"St. Ann's Head, Milford Haven, July 28

"Sir,—The waterspout mentioned in this morning's report was observed yesterday at 4.50 P.M., about a mile outside the port, following in the wake of a squall. Its course lay about N.E., and the progressive movement was judged to be between twenty-five and thirty knots per hour. Its diameter at the base was about 40 ft., and the direction of the whirl from left to right, or with the hands of a watch. The lower portion was well defined, but the middle and upper portions were not so distinct; in fact, the connection with the clouds above, although undoubtedly existing, could not be discerned from our point of view. The sea immediately under it was greatly agitated and white with foam, the spray ascending in a spiral form. Thunder was heard with the squall that preceded it, and the wind veered from S. to S.S.W., although it backed to S. again afterwards. (Signed) JOHN C. WALKER

"R. H. Scott, Esq."

Periodicity of Rainfall

MY attention has been recalled to the letter (vol. viii. p. 547) of my old friend Mr. Meldrum, dated Sept. 15 last, upon the above subject, by its recent republication in a Barbados newspaper. I had intended at the time to examine whether his objections to my statements were valid, but absence from the island and other occupations interfered. On reperusing his letter, I perceive that he notices a disagreement between my figures and those given by Mr. Symons, which requires to be explained, and I take the opportunity of endeavouring to remove his doubts with regard to the correctness of my results. Mr. Symons's annual averages for 1843–61 were drawn from one station, or rather from two; from Fairfield for the years 1843–46, and from Halton, a station nearly three miles distant, and having twice the elevation, for the rest of the period. My averages were taken for the first four years from the same single station, the only record then in existence, and from a varying number of stations during the other years.

Mr. Meldrum thinks that, with certain alterations which he suggests, my calculations will support his theory. I should be very glad if they did. My object in pursuing my inquiries into the rainfall of Barbados has been to assist the planters in forecasting the coming seasons, so as to guide them in their agricultural operations; and I would gladly welcome every contribution to this end, whether it be Mr. Meldrum's sun-spots or Prof. Chase's lunar influences. I was therefore disappointed when I found that the experience of this island did not coincide with that of Mauritius, and I am sorry that a further comparison of the data, which is not open to any objection of discordance of elements, confirms my first calculations.

If I take Fairfield and Halton alone, for the thirty-one years 1843–73, I obtain the following results:—

	Maximum years	Minimum years.
1843–45 ...	—	163·7
1847–49 ..	158·3	—
1855–57 ..	—	170·7
1859–61 ..	186·6	—
1866–68 ...	—	177·8
1870–72 ..	157·1	—
Total ...	502·0	512·2

This calculation shows an annual average excess in *minimum* years of 3·4 inches. But the rainfall at Fairfield during the last three years, for which alone I have the means of comparison, is 13·33 per cent. below that of Halton. Therefore 21·7 inches have to be added to the minimum average of 1843–45, which would increase the above excess to 10·6 inches. If Halton alone be taken for the five periods, the average of the maxima is 167·3, and that of the minima 174·2, yielding an excess of *minima* of 6·9 inches.

A comparison of three stations for 19 years, 1855–73, being the longest comparable period, exhibits the same results. These three stations, Halton, Binfield, and Husbands, are situated in opposite parts of the island, and furnish a fair average of the whole:—

	Maximum years.	Minimum years.
1855–57 ...	—	192·7
1859–61 ...	193·6	—
1866–68 ...	—	182·6
1870–72 ...	162·7	—
Total ...	356·3	375·3

This calculation shows an annual average excess of 9·5 inches in *minimum* years, which differs only by 1·1 *inch from the* above corrected calculations founded on the returns of a single station.

Mr. Meldrum, in his letter of September, writes, that I have "taken 1846 and 1871 as middle maxima years [in my first paper I also took 1848], whereas 1849–72 are probably more correct." Mr. Meldrum is in error as to my having taken 1846 as a middle maximum, as a reference to my former letter (NATURE, vol. viii. p. 245) will show; and I do not find any reference to 1846 as a maximum in Prof. Tyndall's letter, or in that of Mr. Symons, which alone I had seen when I last wrote. In both of these 1848 is named, and I demur to the changes to 1849 and 1872; to the first because, apparently without any sufficient reason, a dry year (48·10 inches) is discarded, and a wet year (67·88 inches) is added, and to the second, not because it affects my calculations, but because no reason is given. The change appears to favour Mr. Meldrum's views, but it scarcely does so, because the estimated quantity of 65 inches in 1873 resulted in an actual average of only 51·26 inches, which would make a difference of 13·74 inches in that year, and would change the trifling excess of 2·64 inches on the maximum side into a larger excess of 11·10 inches on the minimum side.

It is unnecessary, however, to go beyond the calculation which I have above submitted to show that Barbados does not bear out Mr. Meldrum's theory. I am quite prepared to agree with him that, if the preponderance of evidence drawn from a wider area and from longer periods does support it, the opposite results obtained in Barbados, although it is most favourably situated for observations of this nature, being fully exposed to the trade winds blowing over the Atlantic during the greater part of the year, and not apparently subject to any disturbing influences, only show that no particular locality can draw a safe inference as to the manner in which the presence or absence of sun-spots is likely to affect it.

A further consequence presents itself to my mind. It appears to me that the atmospheric influences entering into this question—chiefly evaporation and rainfall—must balance one another pretty equally over the face of the globe, either contemporaneously or by seasons; that the excess of rain received by some places has been drawn from others, which have consequently experienced the opposite effects of evaporation and drought. If therefore certain solar influences, whose presence is indicated by the appearance of sun-spots, have the effect of causing an excess of rain in certain years over so wide an area as Mr. Meldrum supposes, whence does this excess come? If from some atmospheric reservoir, independent of the globe, the excess would be general; the alternations of rain and drought might vary by years or by seasons, more or less long, but not contemporaneously by, or in, localities. If, however, they be drawn from the earth, or from atmospheric strata near the earth, there must be evaporation and drought in those parts whence the excess is drawn. Barbados, as I have pointed out, is singularly free from local influences which would affect its rainfall differently from the rest of the globe. When therefore I find the experience of Barbados differing from that of Mauritius, and of many other parts of the world, I am driven to the conclusion that the influences indicated by the existence of sun-spots are not universal, although they may possibly operate on, and intensify, other influences already existing from other causes; and that the absence of those influences and the existence of different effects in Barbados is not an exceptional result, but a necessary consequence, to be expected in other parts of the globe also, and to be anticipated from the ordinary operation of known physical laws. I shall not, however, be dogmatic on the point, and shall hail further proof of the correctness of Mr. Meldrum's theory as a welcome contribution to the "Meteorology of the future."

RAWSON W. RAWSON

Care of Rabbits for their Dead

SEVERAL months ago you published, among others, a letter of mine, on the "care of monkeys for their dead." Since then I have been making observations upon a similar attention displayed by rabbits, although the considerations which lead to its exercise are apparently much more practical than in the case of monkeys.

Most people are aware that if a rabbit is shot near the mouth of its burrow, the animal will employ the last remnant of its life in struggling into it. Having several times observed that wounded rabbits which had thus escaped appeared again several days afterwards above-ground, lying dead a few feet from the mouth of the burrow, I wished to ascertain whether the wounded animals had themselves come out before dying—possibly for air,—or had been taken out after death by their companions. I therefore shot numerous rabbits while they were sitting near their burrows, taking care that the distance between the gun and the animal should be such as to ensure a speedy, though not an immediate, death. Having marked the burrows at which I shot rabbits in this manner, I returned to them at intervals for a fortnight or more, and found that about one half of the bodies appeared again on the surface in the way described. That this reappearance above-ground is not due to the victim's own exertions, I am now quite satisfied; for not only did two or three days generally elapse before the body thus showed itself—a period much too long for a severely wounded rabbit to survive,—but in a number of cases decomposition had set in. Indeed, on one occasion scarcely anything of the animal was left, save the skin and bones. This was in a large warren.

It is a curious thing that I have hitherto been unable to get any bodies returned to the surface, of rabbits which I *inserted* into their burrows *after death*. I account for this by supposing that the stench of the decomposing carcase is not so intolerable to the other occupants of the burrow, when it is near the orifice, as it is when further in. Similarly, I find that there is not so good a chance of bodies being returned from an extensive warren of intercommunicating holes, as there is from smaller warrens or blind holes; the reason probably being, that in the one case the living inhabitants are free to vacate the offensive locality, while in the other case they are not so. Anyhow, there can be no reasonable doubt that the instinct of removing their dead has arisen in rabbits, from the necessity of keeping their confined domiciles in a pure condition.

GEORGE J. ROMANES

Dunskaith, Ross-shire, July 26

THE NEWFOUNDLAND SEAL FISHERY[*]

THE vessels employed in this fishery are generally built for the purpose at Aberdeen, Greenock, or Dundee; but some obsolete men-of-war have been bought and strengthened to meet the requirements of the trade. Those steamers built for the purpose range from 170 to 470 tons register, and have screw propellers. The *Bear*, in which I went, belonging to Messrs. Walter Green and Co., and commanded by Captain Alexander Graham, a sealing master of thirty years' experience, was a new vessel of the largest class, built by Messrs. Stephens, of Dundee, was barquentine rigged, and had compound engines of 110 H.P.

The smallest rod in the latter was 2¼ inches in diameter, the minimum that has been found to stand the shock of concussion with the ice. Propellers are made in one piece of cast-iron; metal having been tried was found to twist, and those made with separate blades to screw in inevitably broke in the thread of the screw. They are about 7 in. in thickness near the boss and about 2 in. at the point, and should be made without a sling hole, two propellers of the *Bear* having broken at that place. Over the banjo frame are the "slip boards," pieces of hard wood about 3 in. thick, that slide down the screw well on each side of the Sampson posts to prevent ice getting in above the propeller. They should be made to hoist up in one piece with the banjo, otherwise considerable time is lost in unbolting them. The brine from salt-meat casks is kept and poured down boiling to loosen the gear set fast by frost and ice. The propeller may be known to be broken by the great increase in vibration that inevitably follows when in the ice. After watching for a long time I found the effect produced on the engines by the ship striking the ice was scarcely perceptible, and the stoppage of the propeller by ice even at full speed, only caused the connecting rod to vibrate slightly.

The bows for about 20 ft. from the stem are built nearly solid with the numerous beams, timbers, and diagonals; this space is called "the fortification." The bows are sharply built with a raking gripe, the advantage of which is that the vessel does not strike the ice on all the stem at once, but gradually meets the pan, and by the force of the way runs on it as up an inclined plane, and thus adds weight to momentum in breaking a passage. The stem should be full, to carry the ice clear of the propeller, a fine run having a tendency to guide the ice into the screw well.

---

[*] The following notes from personal experience were made in the present year by Navigating Lieutenant Wm. Maxwell, R.N., and communicated to the Hydrographer of the Admiralty.

The vessels are surrounded completely with iron-wood bark about three inches thick; the stern has an iron plate down it, the rudder is sheathed on both sides and abaft, and from the stem about ten feet aft iron plating about half an inch in thickness is bolted. The rudder hole is unusually large to admit a rapid change, and chains are used for steering with.

The "sheer poles," two long spars, are crossed and lashed at one end and suspended from the bows with heavy chains that cross from the bowsprit-cap and one of the other ends on each side from the cat-head. They are intended for men to jump on from the ice when coming on board, or as a temporary resting-place when breaking the ice from the bows or guiding the vessel, and for those purposes man-ropes are slung and a ladder led from the bulwarks to them and the ice. "Pokers," long poles with iron spikes, are used as levers to move the ice, and occasionally as tracking poles. The "crows' nest" is a barrel lashed to the mast-head, fitted with a seat and rest for a telescope and a trap-door, to prevent cold air rising. The hold is divided into spaces called "pounds" by strong partitions, to prevent the cargo shifting with the lurch of the vessel. A tank fitted with a steam-pipe from the boilers, to convert ice into water, completes the list of exceptional fittings in these vessels. The water so made tastes like condensed water at first, but acquires the aeration more rapidly.

Twenty-three similarly fitted steamers went to the fishery this year. The crew, 273 in all, consisted of captain, masters of watches, engineers, firemen, cooks, stewards, and seamen. All share alike, except the captain, in the proceeds of the voyage; but the masters of watches, engineers, and firemen have their pay in addition. The captain has *6d.* currency for each young pelt brought in, and 1*s.* 3*d.* to 1*s.* 6*d.* currency for each hundredweight of old seal blubber.

The men ship in one of three capacities, viz., "gunner," "gunner without gun," and "batsman." If there is much shooting, the gunners get each 10*s.* for the hire of their guns; those with no gun are supplied with them from the ship's stores.

The only necessaries for the men's outfit, besides woollen clothing, are a pair of sealskin boots with thick soles, a lacing at the top to tie them close round the calf of the leg and prevent water getting in, and large pyramidal nails, "frosters," or "sparrowbills," to avoid slipping on smooth ice. A sheath-knife, a small steel, and eye-preservers of glass with wire gauze surroundings, complete the list. The men are furnished from the ship's stores with bats, straight poles 4½ ft. long and 1¼ in. diameter, and "starts," iron hooks and spikes, with a small piece bent at right angles to the butt to stick into the bat. A groove is cut in the latter, and the start is seized in the whole, constituting a "gaff," and combining the uses of boat-hook and alpenstock. A hauling rope, about three fathoms of 1½ in. cordage, to lace up and drag on board the seals, is also supplied.

The men are divided into three watches under masters of watches, who choose their men in turn, one at a time, and each watch is again subdivided under quarter-masters, who are responsible for their men on the ice and are furnished with two numbered flags bearing the ship's name. These numbers are entered against the names of those to whom they are given in a book kept for the purpose, enabling the captain to tell at a glance what men are away by the absence of flags. They are also divided into boats' crews, consisting of "bow" and "after" gunners and two oarsmen, chosen in a similar manner to the watches by the bow-gunners, who take charge of the punts, rough-built country boats, that are numbered to distinguish them. The *Bear* carried twenty-five of these punts.

The men in steamers divide amongst them one-third of the gross catch; the remainder goes to the owners for expenses of outfit and share of the profits. In sailing vessels the men share a half between them, but have to pay 1*l.* to 2*l.* currency berth money for their chance. Nearly 8,500 men were engaged in the fishery during the spring of this year.

When young seals are met with, the men are sent on to the ice, equipped as described. If the seals are not numerous, the ship is kept as close as possible to them; each man secures as many as he can, and drags them to the ship, the first tow being the property of that man who sees the seals first. They are killed by blows on the nose with the gaff, and are then scalped, by drawing a line with the knife through the skin and blubber from chin to tail, and skinning until the ribs on the left side are reached. The knife is then stuck in the heart, to make a hole through which a finger can be thrust to grasp a rib, and the carcase is held in that way till the pelt is removed. The scudders, or hinder flippers, are cut off, and when "panning," one of the foremost paws is taken out to make a hole through which to pass the slings for hoisting on board; but when towed to the ship both are left in to be eaten afterwards. The fore-paws (or "flippers" in the vernacular) when roasted are esteemed great delicacies, and much attention is paid to the cook to obtain permission to cook them.

As soon as a sufficient number are collected for a "tow" (six average-sized young ones being considered enough), the first is laced from the head through one or two holes cut close to the edges of the pelt, so that the hair is on the ice; the second skin is then laid half-way along the first, and the hauling-ropes passed for two turns through both, then for one turn through the second only. The third is then placed on the second, and so on to the last, when the end is made fast. The other end of the hauling-rope is passed through a hole cut in the nose of the first pelt, and a loop is made for one hand to grasp while the other grasps the end over one of the shoulders. The gaff is pushed through the tow-butt behind, and forms a tail to the whole. When the pelts are brought to the ship, they are hoisted thus on board, and each man unlaces his own to secure the hauling-rope and gaff belonging to him.

When the vessel cannot get near the seals or they are extended over a large area, they are "panned" or collected in heaps, each marked with a flag by the different sub-divisions. When taken to the pan the pelts are unlaced and stowed flat, with the hair on the ice, to prevent the sun burning them. If night comes on before the pan is picked up by the ship, a lantern is sent and is watched by a man till the vessel arrives. With the prospect before them of a whole night to be so passed, the men take axes to make ice-houses, and light a fire of the carcases to keep themselves warm. Often, however, the only chance of the men being picked up is to remain by the pan until the ship arrives, without any material to shelter or keep themselves warm.

The pelts are kept on deck at least one night to cool, and are then stowed in the pounds as soon as time permits; otherwise they are a most unsafe deck cargo, threatening to lurch with each motion of the vessel. "Sish," or broken up ice, is sometimes placed between the layers of skins; they are counted when stowed, and the account is kept by the senior "master of watch."

The system of capture is the same with the old seals, but one is considered enough for a tow, and shooting is often resorted to when the ice is at all open, and becomes a necessity in the case of the male "Hood," who fights desperately.

When the vessels are fast in the ice and no seals are near, the gunners are sent away "swatching," or waiting an opportunity to shoot any that may show themselves in the lakes of water near. When sent away for long distances, the men carry a board to rest on, and build ice-houses to protect them from the wind; but at the best it is bitterly cold work. They also take a few biscuits with them, and eat, in addition, the hearts of the young seals, uncooked. The signals for recall are the ensign at the mast-head in clear, and the steam whistle in foggy weather.

The seals taken generally are of two kinds, "Harps," or Saddle-back, and "Hoods," or Bladder-nose Seal.

The "Harps" are distinguished by the sealers as "White Coats" when young, from their colour; "Dippers" after the white coat has fallen off and the spotted skin shows; "Bedlemers" till the saddle or harp is formed; and "Saddle Harps" when they arrive at maturity. "Jennies" or "Tuckers" are the females in the first year of whelping, and "Lords" or "Noggerheads" those deformed from the want of proper nourishment consequent on the mother being driven away or killed. Harps have black claws.

The "White Coat" remains perfectly passive to be killed, and the "Dipper" may be attracted by whistling or singing, and approached till within striking distance; but the mothers take to the water and desert their pups at the slightest alarm. The males are never with their families, but are always to be found on the south-west edge of the whelping ice. This generally consists of ice made on the coast of Labrador with small hummocks on it, that give shelter to the young from the north-easterly winds, the approach of which may be known by the incessant crying of the young Harps. The "harp" or saddle begins to form at the age of one year, is perceptible at the second, and perfect at the third. After that it is difficult to judge the age, but the teeth generally give evidence of extreme age.

The "Hood" is much the finer kind in size and appearance, and is so called from an air-bag covering the head of the full-grown male, that can be inflated at will, and is so when danger is apprehended. It resists completely the blows from a gaff, and the slugs used in sealing do not penetrate it except at close quarters. They can, however, be killed by a blow under and along the line of the jaw, but considerable dexterity is required to effect this, and they can be shot dead by hitting them behind the air-bag or hood. They live in "families," male, female, and pup. Unlike the "Harps," the female rarely deserts her young, but makes a feeble and ineffectual defence in its behalf, and is killed by its side; and in most cases the male offers a desperate resistance, making it unsafe for one man to attack it. They have white claws, and the male attains a length of 7 ft., and has a beautiful dark spotted skin. The young are white with a black stripe down the back, and rarely cry, nor have either sex any sign of the hood. The ice on which they whelp is heavy Arctic ice, rafted into large hummocks, and is generally to the north-eastward of the "Harps." The young of this species come to maturity and take to the water earlier than the "White Coats."

The females of both species are ready for fishing as soon as the young are born, and beat inshore to the shoal fishing-grounds, returning with unerring certainty to the pan on which they had left their young, notwithstanding wheel or drift of ice in the interval. The inference on seeing old seals is that the young are outside; they are never to be seen northward of their whelps. Both species have the power of protruding and withdrawing the teat, so that after the young have suckled, no danger may accrue from crawling over the ice.

When the vessels have secured a large cargo, or at the latest by April 10, they return to St. John's to prevent the loss of the blubber by running from excess of heat. On the south side of the harbour large vats have been constructed, and machines erected for preparing and refining the oil from the blubber. The pelts are taken from the hold and passed through the hands of "skinners," who separate blubber from the skin, take out the flippers, cut off the noses, &c. The blubber is then weighed and the quantity recorded as the catch, less 1½ lbs. for each pelt to balance the flesh left on in scalping. The skins are counted and a deduction of sixpence currency made from their value for every hole found in addition to those necessary for lacing, &c. "Cats" are pelts that weigh less than 25 lbs., and are not included with the other seals, but have a specially low market value of their own, that helps to prevent the animals being taken while too young.

The blubber is thrown into a trough and conveyed thence into tearing machines, two cylinders with rough teeth that grind the blubber and tear the vesicles; thence to tanks, where it is converted by steam into oil and conveyed to other receptacles. A further process of bleaching takes place in reservoirs covered with glass roofs, and sometimes lined with tin, that in a few days makes the oil as clear as water. The refuse is subjected to great pressure to take off the last and worst kind of oil, and is then sold for manure. Seal blubber is valuable in the following order, viz.: that of (1) Young Harp; (2) Young Hood; (3) Bedlemers; (4) Old Harps; (5) Male or "Dog" Hood; (6) Female Hood. The blubber of the last is of much the least value as the small amount of oil contained tints with a yellow colour oil from the other species, and the vesicles are so tough as occasionally to break the teeth of the tearing machines. The skins are salted and exported to England, where they are converted into fine leather and used in the manufacture of ladies' boots.

If the vessels are cleared before April 15, they make a second voyage and hunt the Dippers and old Harps, principally the latter. The Hoods, both old and young, have by that time entirely disappeared. In rare successful cases a third trip is sometimes made, and the vessels do not return till the middle of May. The catch of 1874 has been very poor, from a great number of very young seals having been taken, but in former years as many as 33,000 have been brought in by a steamer from the first voyage.

The ice encountered in the course of the voyage is of various kinds. In mild winters large areas of "sish," or frozen snow and salt water, are met with. This is most difficult to walk on, and the men rarely escape a ducking during a day's tramp. Harp ice is the next in point of thickness, and is generally rafted ice made on the Labrador shore, while the heaviest, or true Arctic ice, large hummocks and heavy pans, is the favourite place of resort for Hoods. Though all icebergs travel from the north, those predominating this year were large, low, and flat; one was seen from twenty to forty feet in height, that was quite two miles measured diagonally. It is dangerous to try to cross their track, because the ice is packed by the pressure of the berg, so that not even a powerful steamer can force her way through. Ice navigation is very uncertain from many causes, but principally from tides, currents, and "wheel" of the ice. When near the land the two former have to be specially guarded against, as the surrounding ice remains the same and gives no evidence of the change of position. In one case a drift of twenty-five miles was experienced in two days; ship, icebergs, and field ice remaining in exactly the same relative positions.

The "wheel" of the ice is caused by pressure of heavier ice on one corner of the field, causing the latter to turn as on a pivot in the direction of the pressure. This is quite uncertain in direction and speed, and no experience can foresee either. Running ice is also a source of danger to vessels fast in it, as they are propelled with irresistible force against any obstacles to their progress—icebergs, rocks, &c. In the spring of 1872 a steamer (*Wolf*) was crushed in an instant by that means, and the vessel went down before the men had time to secure their clothes. Often before a breeze of wind comes the ice rafts or squeezes, layer on layer, with a creaking sound. This also occurs in heavy squalls, and is a source of great danger to vessels fast in heavy ice.

In foggy or stormy weather, the vessel is kept under command, if possible, to clear any icebergs seen, but if not able to move, should be placed broadside to the wind or before it; the danger of being head to wind is, that if the ice anchors carry away and a crack forms under the stern, the force of concussion with the ice may damage the rudder fittings irreparably.

When crossing the water at night and approaching ice, the vessel is always stopped to take the shock gently, and because icebergs loom much like field ice. The whereabouts of water is inevitably shown by a dark horizon, and that of ice by the blink or "glinny."

There are no laws regulating the prosecution of the seal fishery except one passed in 1873, forbidding the departure of sailing vessels before the 5th, and steamers before the 10th of March.

Little Placentia, Newfoundland, June 22

THE INTERNATIONAL GEOGRAPHICAL CONGRESS

THE Organising Committee of the Geographical Congress to be held in Paris in the spring of 1875 have issued a programme of subjects to be discussed during the meeting. The "Commissaire Général" of the Congress is M. le Baron Reille, to whom, at 10, Boulevard Latour-Maubourg, all communications ought to be addressed. The Congress will last eight days, the first of which will be devoted to a general meeting for the purpose of inaugurating the work of the Congress. The members will be divided into sections, each of which will meet separately on the following forenoons to discuss the subjects connected with the section; the afternoons will be devoted to general *séances*. During the meeting of the Congress there will be an exhibition of objects relating to the study of geography, and on the last day prizes will be awarded to exhibitors. The transactions of the Congress will be ultimately published. The conditions of subscription are much the same as those of the French Association for the Advancement of Science.

The sectional sub-committees have provisionally prepared a series of questions for discussion under each section; proposed additions to or modifications of these should be addressed to M. le Baron Reille as above. The sections are as follows:—

I. *Mathematical Section*, including Mathematical Geography, Geodesy, and Topography. The following are some of the questions to be discussed in this section:—Substitution of the centesimal division of the quadrant for the division called sexagesimal; consequences relative to the division of time in astronomy.—Choice of a zero for a general level.—Measure of the differences of longitude; utilisation of telegraphic lines for the purpose of determining longitudes; advantages to geography by the electric telegraph.—Employment of chronometers.—Measure of an arc of the meridian in the southern hemisphere, and particularly in the Argentine Republic.—The most simple instruments and the quickest methods for determining magnetic declination.

II. *Hydrographical Section*, including Hydrography and Maritime Geography.—Among the questions to be discussed in this section are the following:—Choice of a simple and uniform method for reckoning the points of the compass.—Researches concerning the depth to which the agitation of the surface of the sea penetrates.—Study of marine currents; question of the currents in straits.—Determination of the temperature of the sea at different depths; instruments used; selection of the special points where these observations ought to be made.—Causes of the temperature of the Gulf Stream.—Programme of international instructions relative to observations which could usefully be made at once.

III. *Physical Section*, including Physical Geography, General Meteorology, General Geology, Botanical and Zoological Geography, General Anthropology. Among the subjects proposed for discussion in this section are:—New and well-established facts relative to the mobility of the crust of the earth during historical times.—Various theories as to the origin of mountains.—Lithology of the bed of the ocean.—Actual results of recent researches on the influences exercised by astronomical phenomena, such as solar spots, meteoric showers, &c.—To investigate new facts relative to the circulation of the atmosphere and the ocean, the movements of aërial and maritime currents, and their influence upon climates.—To discover the origin and general progress of great atmospheric whirlwinds or cyclones, as well as their periods; to determine their duration, their force, and the extent of the countries exposed to their effects.—Means to be adopted in order to extend more widely the establishment and the discussion of simultaneous meteorological observations, recommended by the International Congress at Vienna.—Geographical distribution of animal and vegetable species during tertiary times; consequences which flow therefrom relative to the climatology of the globe during that period; geographical relation between the quaternary and the existing fauna and flora; extinctions and migrations; distribution of land and water during that period.—Species, genera, and families of plants which are characteristic of the great natural regions.—Also many questions relative to the geology, zoology, botany, anthropology, &c., of the various great divisions of the globe—Europe, Asia, America, Oceania.

IV. *Historical Section*, including Historical Geography and the History of Geography, Ethnography, and Philology.—This section includes questions as to the condition of man both in prehistoric and historical times, comprehending the discussion of many particular points of history and ethnography.

V. *Economical Section*.—This section is concerned with subjects connected wirh Economical, Commercial, and Statistical Geography.

VI. *The Didactic Section* will discuss questions connected with Geographical Education and the diffusion of Geographical Knowledge.

VII. *Section of Voyages*, including explorations and voyages, scientific, commercial, and picturesque. In this section such points as the following are proposed for discussion:—How could a permanent bureau be constituted to indicate to travellers, by land and sea, the *desiderata* of geographical science?—Questions as to the undiscovered portion of Africa, as to the equipment of voyagers and travellers, instruments for various purposes, the bearing of explorers towards natives, narratives of travel, &c., &c.

There are proposed for discussion in the seven sections in all 123 questions, of which the above are a sample; and it will be seen, we think, that if the right men are induced to attend the Congress, and if the discussions are conducted in a truly scientific and candid spirit, great good must be the result to the many branches of science which are more or less connected with the subject of geography.

THE LAST NEW COMET

MR. J. R. HIND, F.R.S., writes as follows to the *Times* from Mr. Bishop's Observatory, Twickenham, August 1:—"From three consecutive nights' observations of the new comet of Marseilles, received from M. Stephan, I have calculated a first approximation to the orbit. It appears the comet will not reach its perihelion till about the 25th inst., but is already slowly receding from the earth, being distant from us at the time of discovery about 55,000,000 miles. Though it may continue visible in good telescopes for several weeks, it is not likely to become an object of any general interest, like the comet which has just left this hemisphere. The elements bear no resemblance to those of any comet previously computed."

THE FORM OF COMETS*

III.

WE are now arriving at a conclusion, for the conditions mentioned are very narrow. In order that a force exerted by the sun may present at any point whatever of the trajectory of a moving body these two radial and tangential components, it is sufficient, and it seems to me absolutely necessary, that this force should not be propagated instantaneously like attraction, but successively, *i.e.* at a definite rate. In order that it may drive to a distance the rarest materials of comets, at the same time exerting only an extremely weak action upon their much more dense and more compact nuclei, it is necessary, and it is sufficient, that this force should be one of surface and not of mass, like attraction. If the light of the sun were due, as was long believed, to the emission of innumerable atoms moving at the rate of 77,000 leagues a second, the force exerted by these atoms would fully satisfy these conditions. Unfortunately, the emission hypothesis has been shown to be false, and is now replaced by that of the undulations of an imponderable fluid on which attraction has no hold. If statical electricity, in order to produce attractions and repulsions, had no need of a particular material medium, such as our atmosphere, we might perhaps be able to call in the aid of that force; but it would still be necessary to prove that the sun is electrical, and that it is able to develop a very marked electric state in comets without acting similarly upon other bodies. As to magnetism, which appears independent of any medium, we know very well that it is not a surface-action, but an entirely specific force, capable of attracting or repelling the densest materials; and besides, the phenomena of terrestrial magnetism scarcely leave room for attributing to the sun a magnetic power sensible at such distances. Finally, electricity and magnetism are polar forces which impart to bodies opposite powers of attraction and repulsion, while cometary phenomena argue only a simple repulsive force.

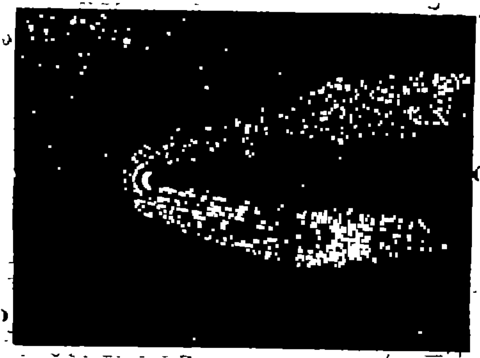


FIG. 8.

There remains the repulsive force of solar heat. In all bodies heat gives rise to a force among the molecules which tends to separate them more and more; it is this which enables our steam-engines to work, and which forces projectiles from our guns. It is evidently a surface-action, and not one of mass; and at least, in maintaining that it is sensible only between the molecules of bodies, *i.e.* that its sphere of action is infinitely small, it is natural to think that the surface of a heated body exerts its repelling action all round it, as well as towards the interior. Moreover, there is nothing opposed to the supposition that this force is propagated successively, since its cause, heat, is itself propagated in planetary space with a definite speed, that of light.

Here is our hypothesis formulated. By introducing his repulsive force, acting by successive propagation, into the differential equations of the movement of comets, along with that of attraction, we see that there springs from them the established phenomenon of their acceleration with its most delicate characteristics.* The analysis which I made has been latterly revised and verified by an illustrious Italian geometer, M. Plana, with developments which leave nothing to be desired in point of mathematical rigour, while the hypothesis of a resisting medium starts, as I have said, with conditions incompatible with the principles of mechanics. It only now remains for us to see whether the same force will also account for the highly complicated phenomena of the figure of comets.

Let us set out from this distinctive characteristic:—The repulsive force exercised at a distance by the incandescent surface of the sun is a surface-action, the more capable of driving off a body, the smaller the density of the body is. According to an estimate deduced from the observed acceleration of Encke's comet, it will be sufficient to reduce, in the proportion of 1,000,000 to 1, the density of the nucleus of that comet to represent the excess of this repulsive force over attraction. The question, then, is, to discover if such great variations of density are exhibited by the various appendages of comets, of which the most compact parts have already so small a mass under so enormous a volume. But this is precisely what facts establish in the most exact and striking manner. The figure of Donati's comet, which I am about to bring before you, shows that the nucleus, in proportion as it is subjected to the heating action of the sun, emits vapours which go on dilating more and more, so as to form around the nucleus envelopes having a radius ten or even a hundred times greater. But if the matter of a sphere with a radius equal to 1 expands into a sphere having a radius equal to 100, it is sufficient to make the density become one million times less. In fact, all the matter of the nucleus is not thus disseminated in the head of the comet; this dilatation affects only a very small portion of the primitive mass, and we see how the density of the extreme layers of the head may fall much below the figure given by the above calculation.

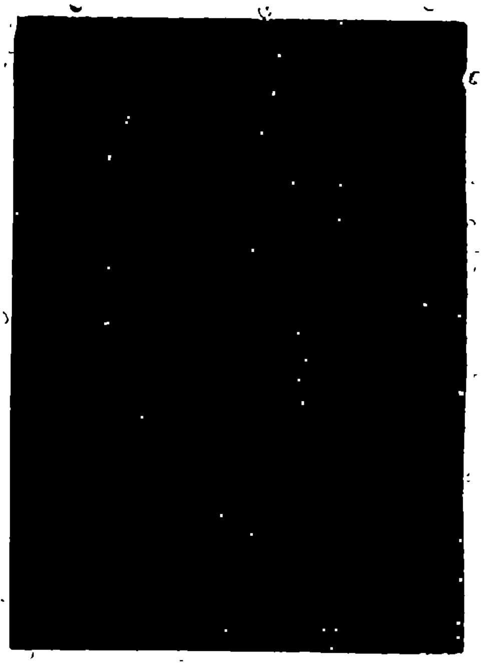


FIG. 9

---

* Continued from p. 248.

* The progressive change of two elements alone, to wit, mean motion and eccentricity; nothing on the position of the plane of the orbit, for the rest, simple periodic inequalities scarcely sensible, but differing, however, from those which the resistance of a medium would give.

We shall understand better what precedes by examining for a little in detail some phenomena presented by the head of the comet of 1858, at the time when the already formed tail was continually fed by materials emitted by the nucleus, and carried away by solar repulsion. (See Fig. 8.)

The concentric zones of a decreasing brightness, which are noticed around the nucleus, on the side next to the sun, are due to an intermittent emission of matter. This matter is seen to dilate more and more with a very moderate initial speed of about 19 metres per second, and finally to reach the limits of the head of the comet; a second, a third, &c. emission closely follow the first, and are developed in the same manner. The brightness, at first very marked, of these successive envelopes of the nucleus grows rapidly weaker in proportion as their density diminishes. Finally, in the exterior layers, the more and more rarefied materials become the prey of the solar repulsion, which makes them turn back, driving them towards the tail at a rate incomparably greater than the former, for in twenty-five days the tail of Donati's comet had reached a length of 14,000,000 leagues; it increased in length at the rate, not of 19 metres, but of 8 leagues per second. I showed, at the outset, to what excessive rarefaction the materials of these immense appendages attain.

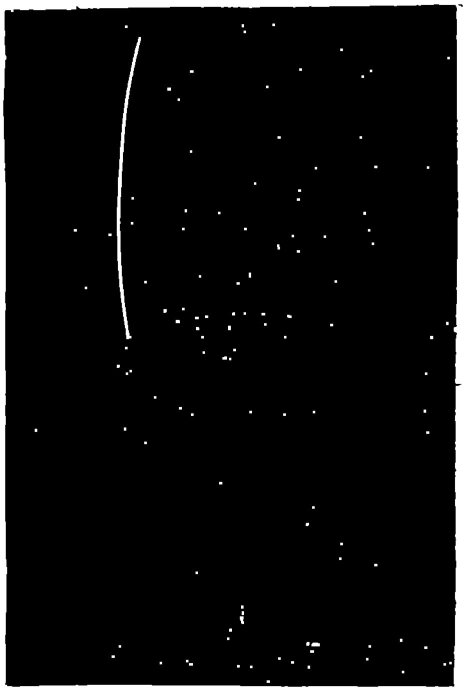


FIG. 10.

You see that upon such materials a surface-action like the repulsive force must have beautiful play, while the solar attraction, independent of the surface and density, continues to act in the same manner upon all these molecules. The struggle, then, between these two forces will turn in favour of the former as soon as the progressive dilatation of the cometary matter, gradually spreading itself in surrounding space, will have brought it to a certain degree of diffusion, and there is nothing to hinder the repulsive action thus becoming twice, three times, even ten times more powerful than attraction.

From the fact that this force, or rather that the radial component of this force, acts in the direction of the radius vector, from the fact that the expelled molecules preserve very nearly the tangential speed which the comet possessed, it necessarily results, as we shall see, that the tails, from the first, must be opposite to the sun and bent in a backward direction.

Fig. 9 represents the successive positions of a series of molecules emitted by the nucleus of a comet so as to constitute the axis of the tail. In this figure, we suppose for the molecules a density such that the repulsive force exactly counterbalances the solar attraction: thus their motion, solely due to the tangential velocity of the comet, takes place in a straight line. To simplify matters, this rate has even been supposed constant, as if the orbit were a circle.

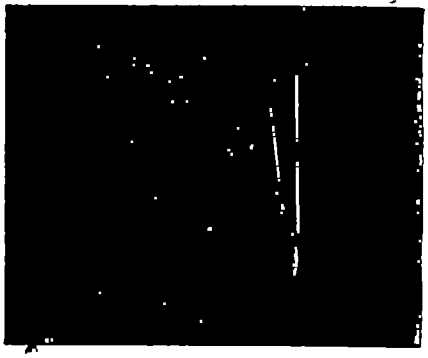


FIG. 11.

On the first day, the comet being at C^1, a molecule m^1 is detached and subsequently follows the line m^1 m^1 m^1.... On the second day, a molecule m^2, likewise leaves the nucleus at C^2, and subsequently describes the tangent m^2 m^2 m^2....Similarly, on the third day, for a molecule m^3, and so on. If we join by a continuous line the series of positions occupied at the same time, the fifth day, by all these molecules m^5, m^4, m^3, m^2, m^1, we shall have the curvilinear axis of the tail; this will be, in this particular case, the involute of a circle. This construction accounts for the three laws which have been ascertained as the result of observation:—1. The tail, at its origin, is sensibly opposed to the sun, S;* 2. The tail is curved backwards on its path; 3. The axis of the tail is a plane curve situated in the plane of the orbit.

FIG. 12.

If the density of these molecules were still smaller, the repulsive force would prevail over the solar attraction, and these molecules would describe no longer straight lines but sections of an hyperbola whose convexity would be turned towards their common focus, S. (See Fig. 10.)

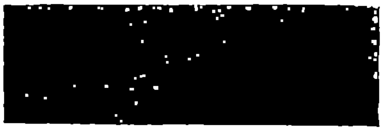


FIG. 13

The series of points m^1, m^2, m^3, m^4, emitted at C^1, C^2, C^3, C^4, by the comet, gives yet another curve like the former, but with a curvature much less pronounced and nearer to the radius vector.

There results from this theory a consequence to which

---

* In reality the axis of the tail is not rigorously tangential at C^5 to the radius vector, it makes with this radius a small angle for which the theory accounts, but which I think may be neglected here for the sake of brevity and simplicity.

I must call your earnest attention, for it is verified in nature in the most striking way and upon the largest scale. All molecules of the same density must naturally group themselves together in the vicinity of the curvilinear axis of the tail m^5 m^4 m^3. . . . and thus form the open plume to which we have referred; but if the comet emit molecules of very unequal densities, on which the repulsive force acts with different energies, there ought to be several distinct tails, more or less curved, all situated behind the radius vector. This is precisely the case with Donati's comet. Fig. 11 proves the truth of this; it shows the comet with three distinct tails. The two smaller tails were almost straight, but always in rear of the radius vector; they presented their less marked convexity in the same direction as the bright tail.

The great comet of 1861 had also two tails. When we saw it for the first time, on June 30, it appeared to have only one, 118° long and perfectly straight, except a singular irregularity for which we could not at first account (see Fig. 12). But soon the two tails separated, and it became evident that we had been deceived by a simple play of perspective. The earth, in fact, on June 30 was in the plane of the orbit of this comet, and as the curvilinear axes of the tails are always situated in this plane, they were united, from our point of view, into one and the same straight line, or at least into one and the same arc of the great circle of the celestial vault. The sketch of the same comet (Fig. 13) seen a fortnight previously by observers in the southern hemisphere, shows clearly the disposition of this double tail, the most curved half of which almost touched the earth with its extremity.

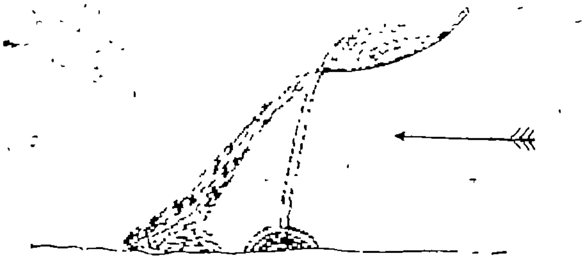


FIG. 14.

These singular effects of the repulsive force are easily explained by a comparison which will appear at first to be far removed from our subject, but the fundamental analogy of which is palpable: I refer to the winnowing of corn. In fact, we cannot better compare the entire surface-action of the repulsive force than to that of a puff of air which repels light bodies and has no sensible action upon denser bodies. When we wish to separate the grain from the chaff by means of the winnowing fan, we allow both to fall gradually into a current of air; the grain escapes from its action and falls at the feet of the winnower, while the chaff, much lighter, is carried to a distance, and forms upon the ground a separate heap (see Fig. 14). If a third material, still lighter than the chaff, is found mixed with the grains placed upon the fan, it will be drawn away still farther, and will form a third heap beyond the second. Evidently the fall into space, under the sole influence of terrestrial attraction, would not operate with such discrimination, for all matters placed upon the fan would fall at the same rate and along the same curve, whatever might be their density.

Well, the repulsive force of the sun—a surface-action, and not one of mass, like attraction—winnows, so to speak, the materials which are separated from the cometary nucleus by being rarefied; it picks them out and distributes them, according to their density, into tails of different curvatures. The lightest form the straightest tails, and those nearest to the prolonged radius vector, while the nucleus, escaping the repulsive action on account of its relatively enormous density, continues to obey, almost rigorously, the Keplerian laws of attraction.

We need not believe that the phenomenon of muliple tails is rare; without speaking of the horrible dragon depicted in Fig. 2, many comets have had several tails. The facility with which the almost straight but very feebly luminous tails of Donati's comet escaped observers in France, leads us to believe that the phenomenon may be general, and that by careful inspection several tails may almost always be found to each comet. And according to theory, a perfect homogeneity of materials, the necessary condition for a single tail, must be, for any celestial body, rather the exception than the rule.

But then, it may be said, if very dense matters are drawn away by nuclear emission on the side next the sun, ought these materials escaping the repulsive action not to take the lead of the nucleus and form a sort of tail on the side next to the sun? Yes, without doubt; and this case is effectually fulfilled, for some rare comets have presented it, such as those of 1823, 1845, and 1851. I would not insist upon these exceptional but not abnormal tails, situated on the side nearest to the sun, almost lying upon the orbit, or at least forming an obtuse angle with the initial direction of the ordinary tails.

(*To be continued.*)

DR. BHAU DAJEE

THIS very remarkable native of India, the true friend of his fellow-countrymen as well as of science and learning, died on May 31 at the comparatively early age of 51 years. As many of our readers may be ignorant of the claims of Dr. Bhau Dajee to notice, we give a brief sketch of his career, for which we are indebted to the *Times of India*.

He was born in 1823 in the village of Manjeren, near Sawunt Warree. His parents were in poor circumstances, and when he was about seven years of age they came to Bombay, bringing him with them. He was first placed in the native Education Society's Schools in Bombay, and afterwards went to the Elphinstone College. There he took a foremost place amongst the scholars, and was noted for his ability and unremitting application to his studies. The highest scholarships were taken by him, and he was specially rewarded with a gold medal. When his studies were concluded he was appointed assistant professor of chemistry and natural philosophy at the college. About this time (1842) a prize of 600 rupees was offered by Government for the best essay in English and Guzerathi on Female Infanticide. This prize Bhau Dajee gained, and the essay, which has since been published, has always been looked upon as one of the best contributions on that subject. He commenced his studies at the Grant Medical College, under Dr. Morehead, in 1845. The college had only then been established for a short time. His success here was again most marked, and gained for him the lasting friendship of many distinguished members of the medical profession. He received his diploma in 1851. He soon created a name for himself as a clever and rising medical practitioner, and quickly found himself in possession of an extensive practice amongst all classes. His time was divided between his medical duties and his historical and philological researches. From the first he took a great interest in all public questions, especially those which affected the interests of his fellow-countrymen. He, with Dr. Birdwood, was instrumental in the establishment of the Gardens and Victoria and Albert Museum, Bombay. The Bombay Association too may be said to owe its existence to his energy; he was the first secretary, and always took a deep interest in the discussions of the society on Indian affairs and measures. A considerable portion of his income was expended in procuring rare and valuable MSS. from Cashmere, Orissa, Benares, and Southern India

These he carefully translated and annotated, and numbers of the translations and remarks appeared in the scientific journals of the day both in India and in Europe. He was president of the Bombay branch of the East India Association, and up to the time of his illness constantly took part in the discussions of that body. His exertions in the cause of native female education procured for him the respect and gratitude of his more advanced fellow-countrymen. He established the Literary and Scientific Society, Bombay, and became its first president. His exertions to procure a recognised system of female education amongst the Hindoos were rewarded by a collection made by his admirers of some 12,000 rupees, which, at his request, was expended in establishing a school which has ever since been known by the name of "Bhau Dajee's Girls' School." He was elected a member of the Bombay Board of Education in 1852. He also filled the presidential chair of the Grant Medical College Society. As vice-president of the Bombay branch of the Royal Asiatic Society, he devoted a considerable portion of his spare time to furthering the interests of the society, and to the museum he presented many valuable contributions. With all the leading public questions of his time Bhau Dajee was familiar, and invariably took part in their discussion. Although he was in possession of a large practice he never accumulated a fortune, as he always willingly and readily gave money for the relief of distress. One of his latest and most important discoveries in medical science was the cure for leprosy, which he was on the point of perfecting when seized with paralysis. While ill he was most anxious that his manuscripts should be collected and got ready for publication. This duty will, we understand, be performed by his brother, Dr. Narayen Dajee, himself an accomplished scholar and well-known medical practitioner. Dr. Bhau visited many parts of India, but never went to England, though we believe he had a strong inclination to do so. Numberless instances of his public spirit and generosity might be cited did our space permit.

The public services of Dr. Bhau Dajee have been so numerous and important that it is but right that steps should be taken to commemorate them by means of a memorial, and we hope that but a short period will be allowed to elapse before some definite proposal will be laid before the public.

The deceased doctor was a member of numerous scientific societies both in India, in Europe, and in America.

OUR SULPHUR SUPPLIES

SIGNOR PARODI has addressed a report to the Italian Government, in which he gives his estimates that the sulphur of Sicily will be exhausted in fifty or sixty years. At present it is on Sicily we depend almost entirely for the supply of our sulphur—that "mainstay of present industrial chemistry"—which is so largely used in our arts and manufactures. Our demand, too, has been a steadily increasing one. In 1842 we imported 16,686 tons, and in 1862 the demand had risen to 75,000 tons. In the production of nearly every textile fabric sulphuric acid is used; it is more or less directly employed in soap and glass-making, metal refining, and the preparation of artificial manures requires large quantities. Our consumption seems to be limited only by the supply.

Recently a correspondent in the *Journal of the Society of Arts* stated, from his own experience of Sicily, that "with few exceptions, the ore is carried to the surface on the backs of boys. . . . The produce of a mine in Sicily is chiefly determined by the difficulty of getting boys . . . and the mines soon reach a depth at which they cease to be profitably worked. All the sulphur in the island, therefore, below 400 feet is untouched." He consequently doubts the correctness of Signor Parodi's estimate.

Still this report of Signor Parodi's is likely to cause some uneasiness, and the prospects of our obtaining a large supply at a cheap rate from Iceland must not be forgotten. The island is but two days' journey from Scotland, and from recent reports on the harbours there seems no reason why a continual intercourse might not be kept up. Many travellers have borne testimony to the immense fields of unworked sulphur there, and the fresh deposition in worked districts is stated to take place at a wonderfully rapid rate. In the celebrated solfatara of Puzzuoli, near Naples, after the mixture of gravel and sulphur has been submitted to the distillation of the sulphur,[*] the gravel is returned, and in thirty years is again so rich in sulphur as to admit of the same process. In Iceland this renewal of sulphur in the gravel is said to occupy but three years; the supply is therefore practically inexhaustible. Estimates show that while Sicilian sulphur is 5*l.* 17*s.* a ton in Britain, Icelandic would be about 2*l.* 18*s.* a ton.

According to a pamphlet by Dr. Carter Blake, recently issued, we learn that a lease for working some of the mines in the northern and eastern provinces of Iceland has been granted to Mr. Lock, of London.

A GREAT TELESCOPE

WE have already referred to the series of splendid gifts from Mr. James Lick, from San Francisco, to the State of California, the whole amounting to 2,000,000 dols. The most remarkable of these donations is one of 700,000 dols. for the purpose of erecting and endowing an astronomical observatory, and equipping it with "a powerful telescope, superior to, and more powerful than, any telescope ever yet made." The author of this magnificent bequest (the *New York Times* states) is in every sense of the word a self-made man, and has followed the wise example of the founders of our Cooper Institute and Lennox Library in securing the proper fulfilment of his trust by providing for its organisation in his lifetime. The United States already possess in the telescope of the Naval Observatory at Washington an instrument of the same gigantic proportions as that erected by Mr. Newall in this country; and we may add that this was the first instrument constructed after Mr. Newall had shown by his costly experiment that such dimensions were possible. The glass for the lenses of both these instruments was furnished by Chance and Co., of Birmingham, England. Under Mr. Lick's gift, Messrs. Alvan Clark and Sons are designated as the final judges of the most appropriate site for the proposed great telescope of California and of the world. How amply endowed will be the Lick Observatory, on the summit of the Sierra, may be conjectured from the fact that the great Washington telescope cost but 44,000 dols. The trustees who have the spending of the 700,000 dols. will be limited simply by the ability of the glass-makers to turn out a lens of sufficient size. We assume (continues the above paper) that the proposed telescope will be a refractor, since the great reflectors, of which the best known are Herschel's and Rosse's, have been found comparatively useless for accurate observations. The great speculum or object-mirror of the former was 49½ in. diameter, and the latter had two specula of 6 ft. diameter. Both were among the marvels of the generations that saw them constructed; but the latter, albeit only thirty years old, is nearly as much out of date as the former, which was constructed eighty-five years ago. It is just possible that the existence of a bequest large enough to yield six times the price which has ever been paid for a telescope may be the means of giving birth to lenses of what would now be reckoned impossible size and perfection. The 26-in. object lens of the Washington telescope has been duplicated in the one ordered by Mr. M'Cormick, of Chicago, for the Washington and Lee University of Lexington; but, though larger lenses have been talked of, their successful production is still problematical. Many costly failures have preceded the attainment of the 26-in. diameter, and Chance and Co. are said to be the only firm in the world who will undertake the manufacture of a disc of that size. Science knows no country, and Mr. Lick's munificent bequest in the cause of astronomy will be hailed by *savans* all over the world.

---

[*] Ure's Dict. of Arts, &c., vol. iii., p. 830.

MENTAL POTENTIALITY IN CHILDREN OF DIFFERENT RACES

MONS. J. C. HOUZEAU, the author of the "Études sur les facultés mentales des animaux comparées a celles de l'homme," has lately concluded, in Jamaica, a series of laborious experimental investigations on the relative or comparative intellectual capacity and development of the children of different races inhabiting that island. The conclusions arrived at by such an observer are worthy of the highest consideration in Europe: while the subject is one that has an important bearing on various popular educational, ethnological, and social questions of the day—such as the unity of mankind, and the possibility or probability of civilising savage races A recent letter addressed to me by M. Houzeau, contains the following brief account of his experiments and conclusions; an account that cannot fail, I think, to be interesting to the readers of NATURE.

"I have been busy, meanwhile, on a curious study about the comparative development of intelligence of children belonging to different races. I had an opportunity here to submit to the test black, brown, and white children. Fifteen of them were sent to me every day for two hours by their parents, my country neighbours: three of them white, seven coloured of various shades, and five black. For a whole year I gave them myself common instruction, and carefully watched their proceedings and their rate of improvement. I do not expect to publish anything about that experiment, at least at this time. But I will state here the conclusions to which it has led me.

"1. There is in each child a different degree of intellectual proficiency, which could be called, in mathematical language, his or her 'personal coefficient.' However, these individual differences are much less than I had anticipated, and are not the striking feature in the unequal rate or speed of improvement.

"2. In this unequal speed, I see nothing—at least nothing clearly and unmistakably discernible—that can be referred to the differences of race. This will probably appear strange after all that has been said of 'inferior races.' Should other facts show that my experiment was not properly conducted, and that the trial was not conclusive, I am ready to give up. Still, it is at least my 'provisional conclusion.'

"3. The rate of improvement is due almost entirely to the relative elevation of the parental circle in which children live—the home influence. Those whose parents are restricted to the narrowest gauge of intellectual exercise, live in such a material and coarse *milieu*, that their mental faculties remain slumbering and gradually become atrophied; while those who hear at home of many things, and are brought up to intellectual life, show a corresponding proficiency in their learning.

"The question of course would require more space and development. I rather mention it as a subject for study than anything else. I had in my life some rare opportunities to study 'inferior races,' including Indians of America, and 'half-breed Indians' of the mixed race of Mexico. I believe most of the *savans* of Europe have but a very incomplete idea of the mental, and still more of the moral, status of 'inferior societies.' Much remains to be said about it."

My present object being briefly to introduce to English readers M. Houzeau's views as to the relative intellectuality of the children of different races in Jamaica, I will not here explain in what respects I differ from his conclusions—how far I regard his experiments inconclusive. I would only remind him, as well as the reader, of the impossibility of duly estimating the direction or amount of future or adult mental development by the study of mental phenomena in the young. It has been, I think, proved, for instance, that—

1. At or up to a certain age girls are as sharp as, or sharper than, boys at lesson-learning and repeating. Cases are constantly being recorded—perhaps paraded—in the newspapers of girls or young women beating boys or young men of equal age in competitive examinations. And yet it is not to be inferred that the female mind is either superior or equal to the male, that is, in a comparison of averages. For the fact is, that throughout the animal series, including Man, the female mind is, in some respects, different from, and inferior to, that of the male. We know, moreover, that female superiority, when it exists, is usually at least confined to school life. In subsequent intellectual development proper, man, as a rule, far surpasses woman. Again—

2. Up to a certain point there is the closest possible parallelism between the mental endowments of the human child and of the young of sundry other animals. At certain stages of development, and in certain animals, the comparison is not even in favour of the child. And yet, though we are still far from knowing what is the range of the mental potentialities of other animals than man, we have no reason for supposing that in any of them will the maximum intellectual or moral development attain to the average in cultured and civilised man.

W. LAUDER LINDSAY

NOTES

AT a recent meeting of the Trustees of the "Gilchrist Educational Trust," they decided to appropriate a sum not exceeding 1,000*l*. to the promotion of scientific research, with the prospect of repeating this grant annually if it should bear adequate fruit. The plan proposed is to ask the Council of the Royal Society to make recommendations to the Trustees, stating in each case the object of the research, the qualifications of the individual by whom it is to be conducted, and the sum they propose to be assigned to him; the purpose of the grant being to assist men of science who have shown themselves capable of advancing science, and who may feel themselves precluded from devoting their time to *unremunerated* work, by freeing them from the necessity of giving up investigations of great promise for the sake of mere bread-earning. We believe that this important movement is due to the representations of Dr. Carpenter, the Secretary, to the Trustees, that they would be in this mode worthily applying about a fourth part of their income in meeting a great national want, and in promoting the second of the objects as to which they have an uncontrolled discretion under the will of the founder—"The benefit, *advancement*, and propagation of learning in every part of the world." The Council of the Royal Society has, we understand, appointed a Committee to consider the conditions under which the Council may most fittingly undertake the responsibility of advising the Gilchrist Trustees as to the appropriation of their grants.

THE matter in dispute between the President and Council of the Linnean Society and a certain section of the Fellows, which caused so much excitement in the Society some months ago, and led to the premature retirement of Mr. Bentham from the chair, was referred to Lord Hatherley as arbitrator, and has just been decided entirely in favour of the President and Council; so that no further action will be taken in the matter.

WE regret to record the death, on July 31, of Dr. Charles T. Beke, whose name is so well known in connection with geography, ethnology, and philology.

We have reason to believe that it is the intention of Dr. J. E. Gray to send in his resignation of the Curatorship of the Zoological Department of the British Museum at the close of the present year. Such being the case, he would retire from office towards the middle of 1875, within six months of his resignation being accepted.

An interesting experiment was recently made by MM. Bertrand and Mortillet, directors of the St. Germains Museum, in the Champ de Manœuvre: the war implements constructed from designs of Trajan's Column were tested, when it was found that the catapult threw arrows a distance of 300 yards. The mark was hit regularly each time up to 180 yards. The same can be said of the *onager*, which sends stones to a distance of 180 yards with astonishing precision, although weighing 1½lbs. The initial velocity was calculated to be more than fifty metres per second, as the time taken to reach the mark is not more than seven seconds and sometimes less than five. All these apparatus are to be tried at a public exhibition to be given in the beginning of next October.

On Saturday last, the "capping day" of the graduates of Edinburgh, the occasion was celebrated by the customary dinner of the Edinburgh University Club, at St. James's Hall; Dr. Cobbold, F.R.S., in the chair. Amongst the distinguished visitors present was the Right Hon. Sir Bartle Frere, K.C.B., who, on replying to the toast of "The Visitors," remarked on the high state of efficiency of the men who entered on Foreign Service, having previously studied at the northern University. During the afternoon a telegram was received from Prof. Balfour announcing that upwards of 100 new graduates were enrolled amongst the alumni of the University.

At the last meeting of the Connecticut Academy of Arts and Sciences, Prof. Marsh made a communication on the size of brains of tertiary mammals, comparing the relative sizes of those of the Eocene, Miocene, and Pliocene. His facts appear to have a very important bearing on the history of the evolution of mammals, and indicate future interesting lines of research. In all the known examples of groups he has been able to compare, he finds those of the Eocene have remarkably small brains; those of the Miocene are larger, and the Pliocene still larger, while the existing species are again still larger.

Dr. G. B. Halford writes to the *Melbourne Argus* on the strength of the poison of Australian snakes as compared with those of India, and also of the efficacy of liquor ammoniæ in counteracting the poison. It is established that the poison of the Australian tiger snake is as deadly as that of the cobra, but Dr. Ewart of Calcutta concludes from experiments that the liquor ammoniæ as a counter-agent is inert. Dr. Halford gives the details of a case in which a greyhound which had been so badly bitten by a snake as to be totally "insensible either to sound or feeling, and never moved," was rapidly brought to life and strength by the injection of ammonia and water into the jugular vein. Dr. Halford thus concludes his letter:—"They have far more advantages in India for these inquiries than we have at present. They have their snake men, who handle the reptiles freely for them—a Government that has already given thousands of pounds for the purpose of experiment and publication. I feel myself a very poor and insignificant rival, and yet there is nothing I should like better than to pursue the subject to the end, if that be possible—not to publish an illustrated work on snakes, with details of all the failures in treatment that have ever occurred, but to discover the best remedy or remedies for the treatment of snake-poisoning. If the Government would assist, I would do the work; or if they would appoint anyone else I would help with every suggestion possible, for in the long interval that has elapsed since my first experiments I have not been idle. It is good in science, as in other things, occasionally to *reculer pour mieux sauter*."

It is said on good authority that the introduction of sheep into the foot hills and higher portions of the Sierra Nevada, in California, is beginning to make havoc of its proper flora.

A Mathematical Society of Bohemia, with its headquarters at Prague, has announced its formation.

The last meeting for the year of the American Academy of Science and Arts was held in May, yet early in June the volume of Proceedings was issued, containing all the papers of the session.

Prof. Silvestri, who has made a special study of the phenomena of Mount Etna, announces that an eruption may be expected shortly.

The Hope Chemistry Prize in the University of Edinburgh, now converted into a travelling scholarship, has been awarded to Mr. R. M. Robertson.

A telegram from Melbourne, of Aug. 1, states that Coggia's comet is visible there and presents a brilliant appearance.

M. Sidoroff, says the *Eastern Budget*, member of the Geographical Society of St. Petersburg, has addressed a report to the Russian Admiralty with regard to the Austrian Polar Expedition, of which nothing has been heard since August 1872. M. Sidoroff says in his report that the *Tegetthoff* was last seen by Count Wiltczek in a gulf near Cape Nassau, whose outlet was then being choked up with ice. Since that time various seamen coming from Novaya Zemlya have reported that the quantity of drift ice in the Icy Sea had considerably increased, and that in the summer of 1873 it was extraordinarily abundant. Formerly the ice on the coast of the above island only extended to a distance of five versts in the month of June, while in midsummer 1873 the width of the icy zone amounted to about 100 versts. M. Sidoroff believes that if Cape Nassau had been free of ice, the *Tegetthoff* would certainly have gone round the north-eastern point of Novaya Zemlya, which is only a day's journey from Cape Nassau, and thus reached the gulf of Yenisesk without difficulty. It is therefore probable that the expedition is frozen up and in want of provisions, and M. Sidoroff accordingly recommends the Russian Government to send food, &c., by land to Cape Nassau, adding that he will contribute 100*l.* to the expenses of the undertaking. The Admiralty has approved of this proposal, and is now taking the necessary steps for carrying it out.

With regard to the question of "Sounding and Sensitive Flames," Mr. A. K. Irvine, of Glasgow, writes—"About twelve years ago I first observed the 'sounding' flame as it occurs on the combustion of gas and air passing through a disc of wire gauze enclosed in a tube, and showed it to one or two scientific friends, but I published nothing on the subject till 1871, when I took patents in this and other countries for a miners' safety lamp, which indicates by a loud musical note the presence of an explosive atmosphere, by the ignition (at the ordinary flame of the lamp) and combustion of the gas and air entering through a disc of wire-gauze surrounding the wick tube."

The annual session of the British Archæological Association commenced on Tuesday morning in Bristol, under the presidency of Mr. Kirkman Hodgson, M.P., and will continue all the week and conclude next Monday at noon. The members of the Association, numbering about 100, and including archæologists from all parts of the country, assembled in the Guildhall, where they were welcomed by the Mayor and Corporation. The party then proceeded to the first point of interest on the day's programme, namely, St. Mary Redcliffe Church; here Mr. F.

Godard, F.S.A., read a short paper on the church. The members of the Association afterwards visited the Temple Church, which is noted for the fact of its tower being 4 ft. out of the perpendicular.

THE great work "On the Marine Mammals of the North Pacific," by Capt. C. M. Scammon, of the United States Revenue Service, has now been completed and is published by John H. Carmany & Co., San Francisco. It forms a stout quarto volume, with many plates, and contains an exhaustive history of the whales, porpoises, and other Cetaceans, together with that of the sea-elephant, sea-lion, sea-otter, the walrus, &c., all accurately figured and described. A specially important section of the volume is that upon the American whale-fishery, giving an account of its origin, extent, mode of prosecution, its progress and present condition, with a full description of all the apparatus used in the capture and utilisation of the Cetaceans, and the incidents of a whaling life. In an appendix is a systematic account and catalogue of the Cetaceans of the North Pacific, by Mr. Dall, a glossary of words and phrases used by whalemen, and a list of stores and outfits. As an exhaustive treatise, even of a limited field of the whale-fishery, this book will probably occupy the first rank in the literature of the subject.

THE Reports and Proceedings for 1873 of the Miners' Association of Cornwall and Devon contain a number of valuable papers on various subjects connected with mining. The Association, we regret to see, is somewhat cramped for want of funds, though we are glad to see from the lecturer's report that much good work is being done in the way of spreading scientific knowledge among the young men of the districts in the midst of which the Association is established.

THE sum of 22 guineas, subscribed by a few gentlemen, having been placed in the hands of the Council of the Leicester Literary and Philosophical Society to be distributed in prizes, in such a manner as to promote the study of natural science, the Committee appointed for carrying out the scheme have resolved to offer the prizes on a plan by which they hope that the interest and co-operation of a large number of persons will be secured, and the Town Museum at the same time greatly benefited. The prizes will be awarded for specimens of Leicestershire rocks, minerals, and fossils; Leicestershire insects and spiders; Leicestershire shells, land and water; Leicestershire plants, including cryptogams. Every specimen must have been collected within the borders of the county; and the other precautions are such as ought to produce a valuable local collection of specimens.

FEW persons are aware of the important exploration which has been going on for a year or two past in Costa Rica, under the direction of Prof. William M. Gabb, a geologist and explorer of Philadelphia, well known for his excellent scientific work, especially in connection with the geological survey of California, under Prof. Whitney. The special object is an investigation of an entirely unknown region of South-eastern Costa Rica, inhabited only by savages, but known to contain rich treasures of minerals, worked by the Spaniards in the early days of the Conquest; this knowledge being only by traditions. Although the party has consisted only of Prof. Gabb and four assistants, it has already gathered a great deal of important information and material in reference to the economical, scientific, and political history of the region investigated. In the course of his labours, Prof. Gabb found the people less savage than had been supposed, and he has already succeeded in winning their confidence to such an extent as to induce their chief to accompany him on a visit to San José. As might have been expected, the geological structure of the country has occupied a large share of Prof. Gabb's attention, and enough has been discovered to warrant the belief that the mineral resources are of great importance. The greatest interest attaches, however, to the discovery of two previously unknown volcanoes, not less than 7,000 ft. high, in the main cordillera just north-west of Pico Blanco. Of these he is about to make a thorough examination. The natural history collections made by the professor are of unusual magnitude and value, embracing all departments of zoology, and especially rich in mammals, birds, reptiles, and insects. Of fish there were but few species, but all that could be found were secured. The ethnology and philology of the country have been attended to very thoroughly. Material illustrating the manners and customs of the people was also gathered in great quantities, and important discoveries made of *Huacas*, or prehistoric graves. In addition to these, Prof. Gabb is on the track of an ancient buried city, of which no mention is made in any history of the country. The natural history and ethnological collections made have been sent to the National Museum, where they form a conspicuous feature in the Central American series. The material thus collected by Prof. Gabb will, on his return, be made the subject of an elaborate work, in which he hopes to present the whole subject of the physical and natural history of the country in its fullest detail. An important geological discovery made by him is that the appearance of dry land on the isthmus is of Tertiary date, and that it is coeval with the period of volcanic excitement in the Californian sierra.

MR. E. DUKINFIELD JONES, of Pyroleira, near Jacareby, province of Saô Paulo, Brazil, writes us that on April 21 he witnessed a most glorious lunar rainbow just after a thunderstorm, at about 8.30 P.M. The arc was one of about 120°, and the secondary bow was just visible though not distinct; but the most remarkable part of the phenomenon was the increase of light over the *whole segment* of the circle. The clouds within the rainbow appeared much lighter than those outside. The bow was quite white, not the slightest trace of colour appearing. The moon was only five days old, and it seems strange that the rainbow should have been so bright with so young a moon. Our correspondent understands that lunar rainbows are very uncommon in that part of the world. This is natural, he states, for *showers* (during which alone the phenomenon can take place) generally occur before sunset and are rare at night.

THE exhibition intended to celebrate the fiftieth year of the Franklin Institute is to be held in Philadelphia from Oct. 6 to Oct. 31. All products of national industry may be sent for exhibition. In addition to three classes of premiums—a silver medal of the Franklin Institute, a bronze medal, and a diploma of honourable mention—cases of special merit may be referred to the Committee on Science and Arts, with a recommendation for the award of the Scott legacy premium or the Elliot Cresson gold medal. The Scott legacy premium—a bronze medal and 20 dols.—is vested in the City of Philadelphia by the provisions of the will of John Scott, of Edinburgh, made in 1816, and the city has confided the trust to the Franklin Institute. The Elliot Cresson gold medal is an honour which has rarely been awarded.

"REPORT on the Physical Character and Resources of Gippsland" (Melbourne, 1874) is the title of a pamphlet of upwards of 60 pp., containing a report of the Surveyor-General and the Secretary of Mines for Victoria of observations made on a recent tour through that part of the colony of Victoria. Gippsland includes that part of the colony between E. long. 145° 50′ and 150°, and contains an area of 13,898 square miles. The report contains many careful observations on the geology, natural history, and resources of the district, and is a valuable addition to our knowledge of the great southern continent. A good map and a geological section accompany the report.

LAST week two remarkably fine examples of the Smooth Hound or Skate-toothed Shark (*Mustelus vulgaris*) were taken in the fish weirs at Rhos Tynach, near Llandudno, and have been secured by Mr. W. Saville-Kent for the tanks of the Manchester Aquarium. The fish arrived in good condition, and have proved to be a pair, male and female. The latter, since its arrival, has presented the institution with six young ones; these are all doing well, already take food, and are now swimming about with the parents in the tank allotted them, 40 ft. long, presenting a most interesting spectacle. Some young herring have been introduced by way of experiment, and the result has been so satisfactory that it is sanguinely anticipated that the Manchester Aquarium will shortly possess as fine a shoal of herring as may be seen at Brighton. The inland position of the former station and the consequent difficulties to be overcome in transit will considerably enhance the value of such an exhibition. The attendance at the weekly lectures and the interest manifested in them continue to increase.

THE additions to the Zoological Society's Gardens during the past week include a Laughing Kingfisher (*Dacelo gigantea*) from Australia, presented by Mr. J. S. White; two Black-handed Spider Monkeys (*Ateles melanochir*) from Central America, presented by Mr. S. W. Rix; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Miss S. Hooper; a Tamandua Ant-eater (*Tamandua tetradactyla*) from South America, deposited; and three Blotched Genets (*Genetta tigrina*), born in the Gardens.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for July contains the following papers:—Note on a new mineral from New Caledonia, by Archibald Liversidge. This mineral is a hydrated silicate of nickel and magnesium allied to *alipite*.—Messrs. Gladstone and Tribe contribute the seventh part of their researches on the action of the copper-zinc couple on organic compounds. The substances now submitted to the action of the couple are the chlorides of ethylene and ethylidene. The dry chlorides are not acted on by the couple, even at a boiling heat, but in presence of water a feeble decomposition occurs. The decomposition is more energetic in the case of ethylidene chloride in the presence of alcohol, decomposition taking place according to the equations:—

$$C_2H_4Cl_2 + 2\left.\begin{matrix}C_2H_5O\\H\end{matrix}\right\} + 2Zn = C_2H_6 + 2\left.\begin{matrix}C_2H_5O\\Cl\end{matrix}\right\}Zn$$

$$C_2H_4Cl_2 + Zn = C_2H_4 + ZnCl_2.$$

Ethylene chloride only undergoes a small amount of decomposition when mixed with alcohol and heated with the couple.—Isomeric terpenes and their derivatives, Part IV., §1.—On cajeput oil, by Dr. C. R. A. Wright and T. Lambert. The oil was fractionally distilled, and the fraction boiling at 176°—179° (giving on analysis numbers agreeing with the formula $C_{10}H_{18}O$) was used for the experiments described. When treated with bromine the compound $C_{10}H_{18}Br_2O$ is produced, and this, on distillation, decomposes as follows:—

$$C_{10}H_{18}Br_2O = H_2O + 2HBr + C_{10}H_{14}.$$

The cymene thus obtained is identical with that obtainable from many other terpene derivatives, since it yields by oxidation a mixture of terephthalic and acetic acids.—§ 2. On the action of pentasulphide of phosphorus on terpenes and their derivatives, by Dr. C. R. A. Wright. The action of this substance appears to be the same in the case of citronellol and cajeputol, a terpene being first produced according to the reaction:—

$$C_{10}H_{18}O - H_2O = C_{10}H_{16}$$

and this terpene by the further action of the pentasulphide splitting up thus:—

$$C_{10}H_{16} + S = H_2S + C_{10}H_{14}$$

The cymene produced is identical with the preceding.—Action of ammonia on phenyl-chloracetamide and cresyl-chloracetamide, by Dr. D. Tommasi. When ammonia is dissolved in a mixture of alcohol and water, and the amides warmed with this solution, chlorine is exchanged for hydroxyl, according to the equation:—

$$\left.\begin{matrix}C_6H_5\\H\\CH_2ClCO\end{matrix}\right\}N + \left.\begin{matrix}NH_4\\H\end{matrix}\right\}O = \left.\begin{matrix}NH_4\\Cl\end{matrix}\right\} + \left.\begin{matrix}C_6H_5\\H\\CH_2HOCO\end{matrix}\right\}N$$

and similarly with the cresyl compound. This new compound, termed by its discoverer *phenyl-hydroxylacetamide*, is decomposed by boiling water, by potassic, sodic, and baric hydrates, this latter substance yielding aniline and some barium salt not examined. *Cresyl-hydroxylacetamide* is obtained by a similar process, and possesses very similar properties.—On Aqua Regia and the nitroxyl chlorides, by Dr. W. A. Tilden. The dried gases evolved from hot *aqua regia* when passed into concentrated sulphuric acid give rise to the deposition of a crystalline substance of the formula $NOHSO_4$, while free chlorine and hydrochloric acid gas escape. The acid nitroxyl sulphate heated with dry sodium chloride yields nitroxyl monochloride (NOCl) as an orange-yellow gas liquefying by a freezing mixture of ice and salt. The author's researches prove that this gas is the only compound of nitrogen, oxygen, and chlorine evolved from *aqua regia*, the reaction being:—

$$HNO_3 + 3HCl = NOCl + Cl_2 + 2H_2O.$$

The concluding paper is by Charles E. Groves, On the preparation of ethyl chloride and its homologues. The author passes hydrochloric acid gas into ethylic or methylic alcohol containing fused zinc chloride in solution. The present part contains its usual collection of valuable abstracts.

THE *American Journal of Science and Arts*, July.—Results derived from an examination of the United States weather maps 1872-3, by Elias Loomis; this we shall notice separately.—Prof. C. F. Himes describes a method of preparing photographic dry-plates by daylight, by desensitising and resensitising the silver compounds.—On a molecular change produced by the passage of electrical currents through iron and steel bars, by John Trowbridge. The conclusions are:—(1) The passage of an electric current through an iron or steel bar produces molecular change in it, which is apparent both at the closing and breaking of the circuit. (2) The rapid change of direction of a current through iron or steel bars produces a molecular disturbance which is greater than that imparted by a current sent in one direction alone. (3) Magnetisation of the iron or steel is sufficient to restore it to the normal magnetic state which is imparted by the magnetising helix. (4) The molecular action increases with the strength of the electric current.—The magnetism of soft iron, by David Sears. Mr. Sears follows up the investigations of M. Jamin given in the *Comptes Rendus* for Jan. 12 last. His results are:—(1). With poles of the same name opposed to each other the magnetisation of an iron bar forming the armature of the two poles is greater on a part of the armature beyond the two poles than it is when poles of opposite signs are opposed. (2) On points of the armature between the two poles the magnetisation is greatest when poles of the opposite names are opposed. A north and south pole attract an armature, therefore, with much greater force than two north or two south poles. (3) M. Jamin's conclusions from the experiments upon an iron bar forming a core to the enveloping helices are as follows:—(3°) "If the theory of solenoids is admitted, the action of parallel currents should be to increase the intensity of magnetisation; on the contrary, it is diminished. (4°) When the currents in the magnetising helices run in opposite directions, they should act opposed to each other on the currents circulating around the particles of the iron, and should diminish each other's action; on the contrary, it is increased. (5°) The action of the helices should be annulled at the middle of the bar. It is not." When the bar to be experimented on forms not the core, but the armature of two electro-magnets, the effects obtained are the reverse of those obtained by M. Jamin, and tend to confirm the theory of solenoids.—Mineralogical notes: Tellurium ores of Colorado; Geology of the Gold Hill Mining Region, with a map.—Notes on diffraction gratings, by John M. Blake, with woodcuts. After a long account Mr. Blake mentions that in many points he has been anticipated by Lord Rayleigh in the Phil. Mag. for February last. The explanation of the origination of the "bands" differs from Lord Rayleigh's.—On the spectrum of the Zodiacal Light, by A. W. Wright. A Duboscq spectroscope with a single prism was employed, the telescope and collimator of which have a clear aperture of 2·4 centimetres. The magnifying power of the former is nine diameters. Special precautions were taken with the observations, and from them is drawn the following conclusions:—(1) The spectrum of the zodiacal light is continuous and is sensibly the same as that of faint sunlight or twilight. (2) No bright line or band can be recognised as belonging to this spectrum. (3) There is no evidence of any connection between the zodiacal light and the polar aurora. The deduction, drawn from the fact of its polarisation, that the zodiacal light is derived from the sun and is reflected from solid matter, is thus strengthened and confirmed by the identity of its spectrum with that of solar light. A discussion of the distribution of the reflecting matter in space is reserved for another article.—On the age of the copper-bearing rocks of Lake Superior; and on the westward continuation of the Lake Superior synclinal, by Roland Irving, with map and section.—On the parallelism of coal seams, by E. B. Andrews. This refers to the difference of opinion already expressed between Dr. Newberry and Mr. Andrews. Their question is whether the ancient shore lines with their coal marshes subsided in an even and uniform way, or very unevenly.

Journal of the Franklin Institute, May and June.—Section: Chemistry, Physics, Technology.—Prof. H. Wurtz's report On the water supply of the cities of Newark and Jersey City is continued, as is also Prof. Thurston's communication On investigations of the resistance of materials.—Dr. Lewis Feuchtwanger contributes a paper On baryta: its manifold uses in the arts. —Dr. C. Cooley describes a new connection thermoscope, by which the sensibility is increased, and its adaptation to a wider range of experiments secured.—Mr. Isherwood reports on Russian coals from the basin of the Don. He states they will doubtless soon be substituted for English coal along the shores of the Black and Mediterranean seas.

Neue Denkschriften der Allgemeinen Schweizerischen Gesellschaft fur die Gesammten Naturwissenschaften, Band xxv. Zurich, 1873.—M. Mousson has made a general revision of the terrestrial malacological fauna of the Canary Islands, discussing and defining, as far as possible, all the species hitherto mentioned; and the results of this inquiry are here detailed in a comprehensive memoir on the subject. It appears that, according to the present state of our knowledge, the Canaries altogether contain 183 certain species of terrestrial and fluviatile mollusca; the largest numbers being presented by Teneriffe (90) and Palma (43); which may, in part, be explained by greater extent and richness of soil, and fuller exploration. The small proportion of fluviatile species is striking (there are only ten); it is probably due to the irregular character of most of the water courses, at times quite torrential, at others attenuated to a mere thread, or wholly dried up. Deposits of terrestrial shells are found at various points of the Canaries; and some lists which the author constructs from M. de Fritsch's inquiries on the subject appear to indicate three different degrees of antiquity in these remains. The deposits of Gomera and Fuerteventura, containing a series of species which have no present analogues, are older than those of Gran Canaria, which do present actual species though modified in the form of varieties; and the latter again are older than those of Teneriffe, the *débris* of which correspond entirely to extant forms. M. Mousson's observations in comparison of the Canarian fauna with those of neighbouring continents and islands are specially interesting. He concludes that the essential part of the malacological fauna of the Canaries is not reducible to any other fauna, and appears to have been developed in a manner perfectly autonomous. The particular features characterising the Canarian fauna consist of the predominance of certain sections of species, or of certain types, which elsewhere do not appear in the same manner, and the elimination of entire genera that occupy an important place in neighbouring fauna. "The only satisfactory explanation of this fact," says M. Mousson, "is that these islands, the objects in which, though often distinct from one another, yet range for the most part about common centres, have formed, since the origin of the present epoch (that is, since the great overturns which have separated the Tertiary epoch from the Quaternary, and opened the era which still continues), an independent whole separated by uncrossable barriers, by the sea, doubtless, from the African and European continents, as also from the Madeira and Cape Verde Islands; which, themselves also, were independent." The differences between the old and recent fauna are attributable (on this view) rather to local overturns connected with the variable and volcanic nature of the ground than to geological and general climatic conditions; for most of the types have remained nearly the same, and have traversed the different sub-fossil fauna that are distinguishable. The diversity of neighbouring forms in the different islands denotes a separation of distant date, but proves nothing as regards the possibility of these islands having once formed a small compact continent, afterwards broken up.—The second and only remaining memoir in this volume is by Prof. Rutimeyer, and has for its subject the fossil tortoises of Solothurn and the rest of the Jura formation. The author's investigation is of a thorough and exhaustive character, and the paper (with its 17 beautifully executed lithograph plates), will be found a valuable contribution to this branch of palæontology.

Revue d'Anthropologie, t. iii. No. 1, 1874.—M. Gustave Lagneau, in the first paper, considers the grounds on which a purely Celtic origin may be ascribed to the primitive inhabitants of the Basin of the Saone and of the Rhone valley and its dependencies; and after sifting the evidence afforded by ancient and modern authorities he is led to ascribe a mixed origin to these peoples.—M. G. de Rialle devotes a long and very comprehensive paper to the history of the peoples of Central Asia.—M. F. Moreno's account of his discovery of some Prehistoric burying-grounds and *paredes*, or ancient Indian habitations, on the shores of the Rio Negro (Patagonia) forms a valuable contribution to our knowledge of the anthropological characters of the primitive inhabitants. M. Moreno's paper is enriched with a table of cranial measurements, comprising a series of results obtained from forty-five skulls.—M. T. Chudzinski gives the result of his observations on the muscular system of the negro, derived from the autopsy of three subjects at the Paris School of Anthropology, reserving for a future number the general considerations to which the facts observed seem to point.—The recent discovery in one of the Canaries of a Libyan inscription, such as has hitherto been found only in Numidia, has called forth some remarks from M. Faidherbe on the ethnology of the Canarian group. The writer believes that the population of the Canaries may be referred to Ouolofs, or West African blacks, to African Libyans, and probably to Phœnicians, besides a later intermingling with Europeans; and it is to the agency of Phœnician traders that he ascribes the knowledge of the Libyan characters and the practice—whose prevalence is amply proved—of embalming the dead, and reducing them to the state of mummies, in which condition they have been found among the natives of these islands.—In No. 2 of this year's series M. Topinard discusses at length the accuracy of Camper's facial angle, and the correctness and sufficiency of the data on which it was based. As the first attempt to establish a system of human craniometry, Camper's definition of the facial angle deserves the greatest respect, and M. Topinard shows that the subsequent depreciation of the value of his method is chiefly due to the vague and variable modes of its application, which originated with Geoffrey Saint-Hilaire and Cuvier. M. Topinard is of opinion that even when used with the greatest attention to the rules which Camper himself prescribed, his method can scarcely be employed with perfectly identical results by different observers, and hence he thinks it would be advisable to adopt some less variable process of determining the maxima and minima for the facial angle. The science of craniology is beginning to assume a more reliable character, and we may therefore hope that craniologists will soon find themselves in a position to adopt some definite and universally applicable method. This, however, can scarcely be attained till the fact is recognised that in craniometric measurements it is the means and not the extremes which we ought to aim at obtaining; the former are alone safe, the latter tend to error.—French geologists are still devoting a large amount of attention to that richest of all palæontological sources, the limestone districts of the Dordogne. In an additional note on the cave of the church at Excideuil, M. Parrot gives us the results of one of the most recent explorations of that region. A careful examination of this cave or crypt has revealed the fact that below the floor, at various depths, lie buried the *débris* of the Quaternary fauna intermingled with the remains of products of industry, belonging evidently to men contemporaneous with the animal deposits with which they are mixed. Reindeer, beavers, bears, are here all represented, and the industrial objects found are similar in character to those of the other caverns, but there are also numerous remains of jasper not met with elsewhere, and the bones have undergone a softening process hitherto unobserved. In other respects the cave of Excideuil offers no novel interest.—M. Hovelacque discusses the ethnological characters of seven genuine Tsigane skulls in the Paris Museum.

SOCIETIES AND ACADEMIES

London

Royal Horticultural Society, July 15.—Scientific Committee.—A. Smee, F.R.S., in the chair.—Mr. McLachlan showed damson leaves affected with a gall produced by *Volvulifex pruni*, a species commonly found on the sloe.—Dr. Hooker sent a note stating that since the last meeting a Ward's case had been received from Mr. Moseley of the *Challenger*, and though all the plants were dead, the soil, when spread out and watered, yielded numerous seedlings of *Pringlea* and *Azorella*.—Dr. Masters exhibited a branch of Privet, furnished with large woody spines.

General Meeting.—Dr. Masters, F.R.S., in the chair.—The Rev. M. J. Berkeley commented on the most important of the objects submitted to the Fruit and Floral Committees.

Philadelphia

Academy of Natural Sciences, Dec. 30, 1873.—Dr. Ruschenberger, president, in the chair.—The following paper was presented for publication:—Remarkable variations in coloration, ornamentation, &c., of certain larvæ of Nocturnal Lepidoptera, by Thos. G. Gentry.—On report of the committees, the following papers were ordered to be printed: Description of seven new species of *Unionidæ* of the United States, by Isaac Lea; Description of three new species of *Uniones* of the United States, by Isaac Lea.

Jan. 6.—Dr. Ruschenberger, president, in the chair.—Dr. J. G. Hunt remarked that the structure of the *Schizæa pusilla* differed widely from that of our other indigenous schizæceous ferns, viz., *Lygodium palmatum*, and its morphological elements are unlike those of our ferns in general. The barren frond of *Schizæa pusilla* is marked on its epidermal surface with a *double line* of stomata, and these organs extend the entire length of the frond. The cells which make up the interior of this delicate fern are cylindrical and vary in size, but their distinctive characters lie in minute projections or outgrowths from all sides of the cells, and these projections meet and are articulated with corresponding outgrowth from adjoining cells, so that the cells of *Schizæa* have penetrating between them in every direction intercellular spaces and channels of *remarkable regularity* and beauty, and so characteristic is this plan of cell-union that the botanist need find no difficulty in identifying the smallest fragment of the plant. This morphological peculiarity has not been noticed before.—Mr. Thomas Meehan exhibited some flowers of *Passiflora quadrangularis*, in which some of them had the pistils almost wanting, while the flowers were perfect in all other particulars. He said it was well known that in cultivation this plant never produced fruit unless by artificial cross-impregnation, but he thought the tendency to abort in the female flowers, and thus approach the classes which were in structure as well as practically uni-sexual, had not been noticed before. There was a species in New Zealand, however, known to be monoecious, and it might be just possible that the *Passifloraceæ*, with mostly hermaphrodite flowers, were following in the wake of the allied *Cucurbitaceæ*, in which a complete separation of the sexes was the rule.

Jan. 13.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy remarked that two species of *Hydra* were common in the neighbourhood of Philadelphia. One is of a light brownish hue and is found on the under side of stones and on aquatic plants in the Delaware and Schuylkill rivers, and in ditches communicating with the same. Preserved in an aquarium, after some days the animals will often elongate the tentacula for several inches in length. The green *Hydra* is found in ponds and springs attached to aquatic plants. It has from six to eight tentacles, which never elongate to the extent they do in the brown *Hydra*. In winter the animal is frequently observed with the male organs developed just below the head as a mamma-like process on each side of the body. He had not been able to satisfy himself that these *Hydræ* were different from *H. fusca* and *H. viridis* of Europe. Prof. Agassiz had indicated similar coloured forms in Massachusetts and Connecticut, under the names of *H. carnea* and *H. gracilis*. Of the former he remarks that it has very short tentacles, and, if this is correct under all circumstances, it must be different from our brown *Hydra*, which can elongate its arms for 3 in. or more.

Jan. 20.—Dr. Ruschenberger, president, in the chair.—Prof. E. D. Cope described some species of extinct tortoises from certain formations of north-eastern Colorado, which had been previously found in the Fort Union or lignite beds of the Missouri river region by Dr. Hayden. He had in 1868 recognised the age of the latter as Cretaceous, contrary to the opinion expressed by some geologists, that the formation both in Dakota and Colorado is Tertiary.—Mr. Cope incidentally mentioned the recent discovery of remains of *Dinosaurs* in the lignite beds of Colorado, which were thus proved to belong to the Cretaceous period, and not Tertiary, as the evidence of the fossil plants had been interpreted by Mr. Lesquereux and others. Dr. LeConte expressed his great satisfaction at the complete confirmation, by his friend Mr. Cope, of the statements he made several years ago (Notes on the Geology of the Survey for the Extension of the Union Pacific Railway, Eastern Division: Philadelphia, Feb. 1867), concerning the Cretaceous age of the lignites at the eastern base of the Rocky Mountains, from near Denver southwards into New Mexico.

Jan. 27.—Dr. Ruschenberger, president, in the chair.—Prof. Cope made some observations on the age of the lignite and other corresponding formations of the West, and especially its supposed equivalent in Northern Colorado. He referred to his determination of the Upper Missouri formation as Cretaceous in 1868; of the Wyoming Bitter Creek series as of the same age in 1872. He now added the Colorado strata to the same, on the evidence of vertebrate remains procured by himself during the past season, in connection with the United States Geological Survey under Dr. F. V. Hayden. These remains consisted of *Dinosauria* of three species, tortoises of five, and a single species of crocodile. Five of the genera were diagnostic. The *Dinosauria* were referred to the old genus *Hadrosaurus* and the new genera *Polyonax* and *Cionodon*. The *Cionodon arctatus* was a large herbivorous saurian, allied to *Hadrosaurus*, but with a most complex and singular type of dentition; the size that of a horse. The other two species are much larger.

Boston, U.S.

Society of Natural History, Feb. 18.—Dr. H. Hagen read a paper On amber in North America, calling attention to a forgotten paper by Dr. G. Troost, published in Silliman's *American Journal of Science*, 1821, entitled, "Description of a variety of Amber, and of a fossil substance supposed to be the nest of an insect, discovered at Cape Sable, Md." This paper contains much more than its title would indicate, giving an elaborate account of the geological formation of Cape Sable Dr. Hagen then described the different strata at Cape Sable, as given by Dr. Troost; comparing which with the profile of the coast of Samland in Eastern Prussia, where most of the amber was found, he showed there was little resemblance between the two, except the occurrence of amber in sandy strata and the agglutination of sand by iron oxide, although whether this sand has any similarity to the glauconite of the amber strata in Prussia he did not know. A striking difference between the amber strata in Eastern Prussia and in Maryland is the occurrence of lignite only below these strata in the latter and only above in the former locality. This fact perhaps indicates some similarity with the occurrence of amber in the so-called *striped sand* of the lignite layers of Prussia.—Dr. Hunt then read a paper on the deposition of clays. Having examined the water of the Mississippi near its mouth, he found it to contain about 1-2000 of suspended matter, chiefly clay, which required from ten to fourteen days to subside. He, however, observed that the addition of sea-water or of salt, sulphate of magnesia, alum, or sulphuric acid, rendered the turbid water clear in from twelve to eighteen hours. He thus explained the ready precipitation of the suspended clay when the river water comes in contact with the salt waters of the Gulf of Mexico, causing thus great deposits of fine mud and helping us to understand the origin of the accumulations of argillites and clay slates which are met with in various geological formations. An explanation of this phenomenon is to be found, Dr. Hunt thinks, in the researches of Guthrie on the formation of drops (Proc. Royal Soc., xiv., 1864). Studying the size of drops of water falling from a small sphere of ivory, he found that the cohesion of the water was diminished when it held saline matter in solution, as was shown by the smaller size of the drops. This was verified by experiments with solutions of various strengths, of nitre and chloride of calcium. It was found that the addition of eight parts of the latter salt to 1,000 parts of water reduced by one-ninth the size of the drops, which was determined by their diminished weight. These results show a diminished cohesion of the liquid to the ivory sphere, from which it was by the force of gravity made to fall. The cohesion in virtue of which extremely attenuated particles of clay are held in suspension in water in opposition to gravity, is in this manner so far reduced by the addition of saline matters that gravity and cohesion rapidly assert themselves among the suspended particles, which collect together and subside, leaving the saline liquid clear. The precipitation of suspended clay is made very rapid when a strong solution of salt is employed.

Vienna

Imperial Academy of Sciences, March 12.—M. Puschl communicated a paper on heat of bodies and ether-density. To explain Dulong and Petit's law, he assumes that, in solid bodies, the *vis-viva* of atom-motion is small compared with the quantity of rays collected in the ether between the atoms, through reflection; that, at ordinary temperatures, bodies are nearly quite opaque for their own internal radiation; and that the chemical equivalent weights of bodies are no relative atomic weights, but weight quantities with equal amounts of atom surface. He thinks that possibly all chemical changes in bodies may be accounted for by heat radiation. The heat of bodies consisting mainly in motion of ether, a means is given of determining the lower limit of density of the latter; and M. Puschl considers it must be more than 26 billionths of that of water (regard being had to the specific heat of water).—A note from Prof. Maley stated that he had been able to make the urine of dogs alkaline through simple removal of the acid gastric juice from the body. —M. Oppolzer, from experiments on the velocity of propagation of the electric current, estimated it at 4,000 geographical miles in a second.—Prof. Bohm read a paper On formation of starch in the germinating leaves of cress, radish, and flax. He opposes Kundt's view that starch developed among the chlorophyll granules, on exposure to light, is an assimilation-product formed immediately from decomposed carbonic acid. He considers it rather a transformation-product of reserve nutriment already present in the cotyledons (adducing evidence of this from various experiments).—Dr. Streintz communicated a paper On deadening of torsion-oscillations of wires. Internal metal-deadening (as he calls that part of the deadening which has its cause in torsion of the wire), does not, he finds, follow the laws of air-deadening. One property they have in common; the logarithmic decrement for different amplitudes is the same. But the metal deadening remains unaltered when the moment of inertia is changed, or the wire lengthened or shortened, and so the time of vibration altered. It is independent of the diameter and tension of the wire; it grows quickly with the temperature. Annealed wires show a much less deadening than unannealed. These properties explain some peculiarities of musical instruments, and may be variously utilised.—M. Schrauf presented a note on the thermo-electric properties of various minerals.

March 19.—Prof. Mach communicated a third paper On the sense of equilibrium, giving a formula which applies to pressure of parts of the body on each other, muscular efforts, skin sensations, hydrostatic blood pressure, and the hypothetical functions of the labyrinth.—Dr. Boué gave an extract from his treatise on the constituent parts of mountain chains, on mountain systems, and comparison of the surfaces of the earth and moon. He criticises M. Elie de Beaumont's theory, regarding it as merely a fragment of a more general orogeny.

Gottingen

Royal Society of Sciences, Feb. 7.—M. Grisebach read a paper On a collection of plants made by Prof. Lorenz in the provinces of Cordova, Santiago del Estero, Tucuman, and Catamarca, in South America (between 26° and 31° S. lat.). The diligent labour of two years, and in widely different localities, furnished only 900 species, showing how little varied, comparatively, are the Argentine flora. Neither climate nor soil seems to account for this homogeneity. The author considers it explained by the fact of this part of South America having been raised out of the bed of the Atlantic later than the neighbouring regions of Brazil and Chili, long geological periods being necessary for the appearance of new organisms. As to the question whether there has been only immigration of species, or new species have arisen independently, it appears from comparison of Brazilian and Chilian flora that the latter is true; the number of endemic species is about 43 per cent., a proportion similar to that in flora regarded as independent. Among the immigrant species the relationship to Chili is most marked.—M. Kohlrausch communicated a paper On thermo-electricity, conduction of heat, and electricity. He sets out with the hypothesis that with a heat-current of certain amount dependent on the nature of the conductor, an electric current is connected; and explains by means of it the phenomena of thermo-electricity. To explain Peltier's observation of development of heat by an electric current at a point of junction, it is added, that heat is moved by an electric current; and the heat-moving force of the unit electric current in any body is proportional to the electromotive force of the unit heat-current in the same body. This suggestive paper also treats of the relations of the hypothesis to the principle of conservation of energy, displacement of the thermo-electric order of metals by temperature, heat conduction and work, &c.—M. Heymann presented a paper On an Indian drama, Bharata's Natyaçastram.—M. Enneper discussed some theorems relating to surfaces of the second order.

Paris

Academy of Sciences, July 27.—M. Bertrand in the chair —The following papers were read:—Action of differently refrangible rays on iodide and bromide of silver; influence of colouring matters, by M. Edm. Becquerel.—On the Algerian meteorological tracing, by M. Ch. Sainte-Claire Deville.—Objections to the method of uprooting vines for the destruction of *Phylloxera*; indication of another process; a letter from M. C. Naudin to M. Elie de Beaumont.—Report on M. Canvy's memoir concerning the means of preserving vines from the invasion of *Phylloxera*, by the Commissioners.—Researches on explosive bodies: explosion of powder, by MM. Noble and F. A. Abel, first memoir.—Note on the quantity of water consumed by wheat during its growth, by M. Marié-Davy.—Actual state of the invasion of *Phylloxera* in the Charente provinces, extract from a letter from M. M. Girard to M. Dumas.—Indications given in 1845 of the existence of an ancient sea in Algeria, in the meridional portion of the Atlas, and on the possibility of re-establishing this sea, by M. Virlet d'Aoust, in a letter to the perpetual secretary.—On the production in the same medium and at the same temperature of the two varieties of sulphur, octahedral and prismatic, by M. D. Gernez.—On the action of ether on cupric oxide for transforming it into cuprous oxide and into metallic copper, by M. A. Guerout.—On isoterebenthene, by M. J. Riban.—On a division of the fibrin of blood from whence is derived a substance analogous to ordinary albumen, by M. A. Gautier.—On the anti-putrid property of the heavy oil of coal-tar, by M. L. Dusart.—New process for the manufacture of the so-called "*alunated*" stuccoes or plasters, by M. Ed. Landrin.—On decomposition of albuminoid matters *in vacuo*, by MM. N. Gréhant and E. Modrzejewski.—Storm of May 26, at Vendôme (Loire et Cher); thunderbolt; scheme for a simplified lightning conductor, by M. E. Nouel.—On the metamorphoses of *Sacculina Carcini*, by M. A. Giard.—Note on the development of the spermatozoids of the brachyurous decapods, by M. P. Hallez. —On the origin of the hot winds of the Alps and the physical constitution of the Sahara, by M. Ch. Grad.—On a vitreous feldspathic orthose from the Isle of Rachgoun (Algeria, province of Oran), by M. Ch. Vélain.—Note on the geology and palæontology of the estuarine formations of the upper tertiary at the environs of Oran, by M. Bleicher.—On the phosphates of lime from Ciply, in Belgium, by M. Nivoit.

CONTENTS

PAGE
Hitzig v. Ferrier 259
A Marine Aquarium for Inland Students 260
Foster's "Physiology" 261
Our Book Shelf 262
Letters to the Editor:—
  Flight of Birds.—His Grace the Duke of Argyll 262
  Exhibition of Specimens and Apparatus at British Association Meetings.—E. Ray Lankester 263
  A Waterspout at Milford Haven.—Robert H. Scott, F.R.S.; John C. Walker 263
  Periodicity of Rainfall—Governor Rawson 263
  Care of Rabbits for their Dead.—George J. Romanes 264
The Newfoundland Seal Fishery. By Lieut. W. Maxwell, R.N. 264
The International Geographical Congress 267
The Last New Comet. By J. R. Hind, F.R.S. 267
The Form of Comets, III. By M. Faye (*With Illustrations*) . . 268
Dr Bhau Dajee 270
Our Sulphur Supplies 271
A Great Telescope 271
Mental Potentiality in Children of Different Races. By W. Lauder Lindsay 272
Notes 272
Scientific Serials 275
Societies and Academies 277

THURSDAY, AUGUST 13, 1874

ICELAND'S MILLENARY

ANNIVERSARIES are nearly as old as history, and are of constant occurrence; centenaries are of comparatively modern date, but have been not infrequent during the past thirty years; a millenary, however, must not only necessarily occur with extreme rarity, but there are many chances that in a thousand years an event which was long held of the greatest moment may be looked back upon with comparative indifference, may have dwindled into comparative insignificance, as seen from a new point of view or in the shadow of some more stupendous occurrence; or the individuality, whether a nation or a wide-spread association, in whose career the event was held to be of prime importance, may have become either extinct or absorbed in some wider individuality, which may not be so impressed by the memory of the episode as to be moved to celebrate its millenary. The Icelanders then have reason to congratulate themselves that they have kept their individuality intact for so long, as to be now celebrating the 1,000th anniversary of their origin as a distinct and separate community.

It will be found on examination that men keep alive the memory, by festival or otherwise, of any event because that event marks the beginning or the renewal of life in an individual or a community. There are many events in the history of individual nations and of the world which might thus very appropriately be annually or centennially remembered; there are not a few occurrences in the history of our own country that well deserve such a commemoration on account of the new impulses they gave to our national life and our intellectual progress, as well as indirectly to the advancement of the world at large. We believe that, on the whole, this periodical celebration of the occurrence of events which mark certain stages in the progress of a community or of the world serves a good purpose and ought to be encouraged; it affords us an opportunity to take stock of our gains, to measure the extent of our progress, to see wherein we have erred and how we ought to mend our ways; and last, but not least, it gives the world an excuse for learning something about the important events which have marked its history.

This celebration of the 1,000th anniversary of the colonisation of Iceland ought to excite the interest of a wider circle than the few thousands who fondly cling to the bleak but picturesque Arctic outpost which has been the home of themselves or their ancestors for a thousand years, and where they have maintained stereotyped, as it were, the physiognomy, dress, and manners of a people that were at one time rulers of the sea and very nearly lords of all Europe. It would be an interesting task to investigate the causes which have brought it to pass that a people at one time so overflowing with energy as the old Norsemen, should for some centuries now have been justly regarded as the most peaceable, industrious, and most home-keeping people in Europe. As everyone knows, for about 200 years from about the middle of the eighth century A.D. the Norse rovers, the "vikings," the men of the viks, voes, or bays, were to be found on almost every sea of Europe, rousing to activity or over-mastering the exhausted southern nations. It was no doubt good for our own land that it should receive such a large infusion of this energetic northern life, as it did, first in the shape of Danish invaders and settlers, who have left a broad mark on the northern counties of England, the south and north-east and west of Scotland, and again in the shape of the Normans who shed themselves over the land under the leadership of Duke William. These Norsemen, one of the branches of the great Teutonic kin, seem to have taken kindly enough to the wild, roaming life of sea-rovers, and hardy indeed they must have been to weather the hazards of the sea in such craft as they then could command. But, after all, it should be remembered that even in the eighth and ninth centuries Europe had not quite subsided from the commotions which followed on the coming in from the east of the great Teutonic wave, and as the Scandinavian offshoot was probably one of the latest to reach its destination, the great northern peninsula, we need not be surprised that it was one of the latest to settle down to a quiet and home-keeping life; it did so only after sending out wavelets in all directions, east and west and south, which wavelets produced impressions that have continued for good even until now. As seen in the stories, historical and legendary, that come down to us, these hardy Norsemen of yore were a glorious race of men, half barbaric as they were, full of the greatest capabilities and a splendid energy, to the infusion among us of which we ourselves are no doubt indebted to a considerable extent for the capacity which has enabled us to attain such large intellectual and material achievements, and for that never-subdued love of liberty which in all directions has been so fruitful in results.

Even in Iceland, cut almost entirely off as it has been since its colonisation from the influences that have stirred and moulded the rest of Europe, the fine energy of its Norse Colonisers has by no means died out. Yet this old Norse Colony cannot be said to have advanced much beyond the standpoint it occupied a thousand years ago. The Icelanders have no doubt produced much literature that must be of permanent value both intrinsically and as an all-important aid to the scientific student of language and of the human race. Still they must, we fear, be looked upon as a thousand years behind the rest of Europe, and a study of their present condition will afford an excellent means of estimating the immense advances which the civilised world as a whole has made during the last thousand years. And to what is this advance owing? Is it not simply that in Europe generally, knowledge has been spreading in an increasing ratio, and that our knowledge has been becoming more and more scientific? Would not a survey of the nations of the world show us that those nations in which science is cultivated to the highest possible extent alongside of other fields of intellectual activity, are the nations which hold the front rank in the march of the world's progress? In short, it will be found, we *believe*, that the world's progress and science are almost convertible terms. But science to be of any practical utility requires something to work with, and that something in the case of our own nation is Coal. The student of history ought to bear this in mind, and thus he will see that in Iceland, however far theory might have gone, geology would for ever have forbidden any great national advances as depending on science. Here is a tremendous thought for our statesmen and political economists. England without science would have been in the position of Iceland without coal!

The early visitors to Iceland are said to have found traces of former visitors in the shape of books, crosses, bells, &c., which it is supposed may have been left by monkish voyagers or fishers from Ireland, which at that time was pre-eminent in Europe for its learning. And this learning was the secret and the reason of Ireland's early pre-eminence; and it is only by the spread of education and by bringing the people under the influences which have done so much for the rest of Europe, that she can ever regain the position she once so proudly occupied. The Icelanders, on the other hand, seem to have improved as far as their opportunities have allowed them; but these opportunities have been comparatively few and unimportant. Now, however, that Denmark is handsomely to grant the island a reformed constitution, and that the eyes of the civilised world at large have been attracted to it, we hope Icelanders will be led to develop, by means of education and scientific knowledge, their own latent capacities as well as the capacities of their island home, which, like themselves, seems as if it were the "fragment of a former world." It is almost too trite to say that it is wonderful what human energy will accomplish under the most adverse circumstances when directed by scientific knowledge and stimulated by the encouragement and the hope of the approval of our fellows. And if the Icelanders generally had among them the opportunities of bringing themselves abreast of the rest of the world as far as education is concerned, and especially in respect to a knowledge of the methods and results of science, if even a very few of the permanent inhabitants became competent observers of nature, might we not rationally look for results that would shed considerable light on various important points in science—in geology, for example, and meteorology—that are waiting to be cleared up? Iceland, indeed, might very well become the world's polar observatory. Let us hope that this new episode in the history of Iceland may be productive of widespread and lasting benefit to the people themselves, and lead to an increase of the general sum of intellectual progress; and all peoples who can in any way claim to a Norse connection ought to sympathise with their old-fashioned brethren in their rejoicings, and lend them a helping hand to enable them to partake of the many good results which Norse energy has helped to achieve. Their quaint old Sagas, we are sure, would not give less pleasure during the dreary nights of their long winter, if told to an audience whose resources of rational enjoyment have been increased by a knowledge of "the fairy tales of science, and the long results of time."

The Icelanders themselves have good reason to remember the period of the colonisation of their wild island, for it was carefully planned and judiciously carried out a thousand years ago, and obtained effectually for its originators that freedom which they were in great danger of losing under the tyranny which then oppressed their native Norway. And here we may state, as a curious fact, that the millenary festival of the establishment of the kingdom of Norway itself took place only two years ago. That, and the festival of which we speak, are, so far as we know, the only celebrations of the kind that have hitherto been kept.

It was about the year 861 A.D. that Iceland was first seen by the Norsemen, the story being that in that year one Naddod, a vikingr, a leader of one of the then frequent plundering expeditions, was driven by a tempest on the eastern coast of this then unknown country, to which he very naturally gave the name of "Snjóland." No doubt Naddod would tell the story of his accidental discovery to his own folk when he returned home from his roving expedition, and it was possibly this story that instigated Gardar, the Swede, whose home was in Denmark, to visit the new-found land.* This Gardar seems to have found a good harbour near the present Austerhorn, where he wintered, and in the following year completed the circumnavigation of the island, which he renamed after himself "Gardarsholm." The next visitor to the yet uninhabited island is said to have been a "mickle" Norwegian vikingr, Floki "Volgertharson," who struck the east coast a few years after Gardar, and sailing south and west landed at Vatna Fjord in Bardestrand. Floki explored the country to some extent, and would have settled therein with his followers had not their cattle all died. He, however, appears to have passed a second winter at Hafna Fjord, returning home in spring full of information concerning the new land, which, the chronicles say, was at that time covered with wood, and otherwise more inviting than it is at the present day. Indeed, one of Floki's companions is said to have given quite a glowing account of the country; the very grass, he said, "dropped butter." From the large quantities of drift-ice which he found in the northern bays, Floki gave the island the name by which it has been ever since known—Iceland.

By this time the overbearing conduct of the Norwegian king, Harold Haarfager, had so galled his high-spirited nobles that to many their country had become intolerable, and they were quite ready to welcome any chance of escape from their monarch's oppressions. Love and murder, however, seem to have been the immediate causes of the first deliberate emigration from Norway of a band of colonists for Iceland. Ingolf and Leif, the story goes—and we believe its main features may be relied on as authentic—were two cousins, whose fathers had been obliged to fly from their native province for murder. Ingolf had a beautiful sister, Helga, whom Leif loved, but she was also loved by Holmstein, one of three sons of a powerful Norwegian noble, who were companions of Ingolf and Leif in their piratical excursions. Leif married Helga, and had therefore to meet Holmstein in mortal combat, when the latter was done to death. This and other occurrences made Norway too hot to hold the two cousins, who, indeed, had been condemned to banishment. After two piratical trips to Ireland, from which they returned with great booty, the cousins with their families and friends and Irish slaves, their goods and their chattels, bade farewell to their native land in the year 874 to found a republican colony in Iceland. Ingolf was first forced to land on a promontory on the south-east coast, which was hence named Ingolfshöfde, where he remained three years, at the end of which time he removed to the site of the present capital, Reikjavik ("Reeky Bay"), where superstition apparently determined him to remain, notwithstanding the remonstrances of his servants, who had seen many more inviting spots along the coast. Meantime Leif, or Thorleif as he was now called, from a big sword he brought back with him from Ireland, had built his house at Thorleifshofde, where, in the first spring after his arrival, he began to cultivate the ground. Having only one ox, however, the story goes, he compelled his Irish slaves to draw the plough; they thereon rebelled and murdered their master, they themselves being in turn pursued and nearly all killed by Ingolf, who then appropriated all the country between the river Olousa and Hval Fjord. The oppressions of Harold the Fair-haired soon sent many of the best of Norway's sons to become settlers in the new colony, and thus it was that Iceland was peopled, not by the scum of the mother country, as is too often the case, but by the best blood of old Norway. This influx of colonists continued for sixty years, when, the causes of emigration from Norway having ceased, and the best ground in Iceland having been fully occupied, immigration gradually came to an end.

---

* But according to the tables in Rafn's "Antiquitates Americanæ," it was Gardar who discovered Iceland in 860.

From the first the colonists seem to have set themselves to make the best of their not very promising surroundings, and ere long to have settled down into a comparatively peaceful and contented community. One Ulfleet is said to have compiled a code of laws, and instituted the "Althing," or National Assembly, in 928, when for the first time it met at Thingvalla. Among other enactments pauperism was suppressed as a crime by the severest laws, one of which was intended effectually to prevent the procreation of a pauper class in a country where it was only by dint of the hardest labour that the sea and the land could be made to yield enough for all. The colonists were converted to Christianity about the year 1,000; in 1261, after many internal contests, the whole island swore allegiance to the Norwegian king, but about 1387 it was transferred to Denmark, attached to which kingdom it has ever since remained. The King of Denmark is now on the island—an event of the rarest occurrence—and, as we have said, is to grant to his Icelandic subjects a new and liberal constitution; we believe he is accompanied by Prof. Steenstrup.

This, deprived of detail and of much that is doubtful—though the Icelanders have less of the legendary in their early history than most other old countries—is the story of the colonisation of Iceland a thousand years ago. We have not space to enter into further detail concerning the physical aspect of the island, the character and customs of the people, their wonderful literature in all departments of intellectual activity, their discovery of and long intercourse with Greenland and North America. Greenland was seen by an Icelander, Gunnbjorn, so early as 877, and for centuries after some rocks between Iceland and Greenland were known as "Gunnbjorn's Skerries." Erik Rauda ("the Red") first visited Greenland in 983; three years afterwards he planted a colony on the south-west coast. We understand that a deputation from America is attending the millenary fêtes now being held in Iceland, and that some of the American scientific societies have shown their good-will by sending valuable presents of books, &c. This is right and becoming on the part of the Americans; for, as we have just indicated, the Icelanders were the first European colonists of America, and had regular intercourse with the western continent for about 300 years; and it is curious to conjecture what might have been the history of that continent had the Norse attempts at colonisation not proved abortive. It is by no means improbable that Columbus himself, when he made that northern voyage in 1467, "a hundred leagues beyond Thule," may have heard some fragmentary traditions of the Greenland colony which he may have treasured in his heart as a confirmation of the idea which was subsequently to bear so rich fruit.

The history of this old Norse colony proves that the people have great capacity for work, and we again hope that this celebration of the courage and dauntless energy of their forefathers will be the means of rousing them to renewed activity, which will be beneficial both to themselves and to the world at large, which has increasing need of all the really good working power it can command.

RECENT RESEARCHES IN PHOTOGRAPHY

A SUBSTANTIAL contribution has been recently made to our knowledge of the action of light upon silver salts—a contribution which we cannot but consider as of the highest importance to photography, both as a science and as an art.

In the autumn of last year Dr. Herman Vogel announced * as the result of some experiments that he had been making, that "we are in a position to *render bromide of silver sensitive for any colour we choose*—that is to say, to heighten for particular colours the sensibility it was originally endowed with." This discovery is such a decided advance that it will be interesting to trace it from the beginning. Dr. Vogel, in the first instance, found to his astonishment that some dry bromide plates prepared by Col. Stuart Wortley in this country were more sensitive to the green than to the blue portions of the spectrum. This result was so totally opposed to the generally received notions that the subject was submitted to further examination. In the next experiments a comparison was instituted between dry bromide plates and the same plates when wet from the bath solution of silver nitrate. The results showed a decided difference in the behaviour of the plates. The sensibility of dry bromide plates appears to extend to a greater extent into the least refrangible end of the spectrum than is the case with *wet* plates. In Dr. Vogel's plates, in fact, which received the spectrum formed by the battery of prisms of a direct vision spectroscope from a ray of sunlight reflected from a heliostat and passing through a slit 0·25 mm. wide, the photographic impression of the spectrum, when developed by an *acid* developer, extended in the case of the dry plates into the orange, but with wet plates not quite into the yellow. The bromide plates prepared by Vogel, moreover, did *not* exhibit that increased sensitiveness for the green rays which characterised Col. Stuart Wortley's plates, and this led the German investigator to conjecture that the latter plates contained some substance which absorbed the green to a greater extent than the blue. To test this conclusion one of the plates was washed in alcohol and water in order to remove the yellow colouring matter with which the plate was coated, and it was then found to have lost, in accordance with Dr. Vogel's anticipations, its sensitiveness for the green rays. The peculiar action of the Wortley dry plates was thus shown to be due to the coating of colouring matter, and the next step made by Vogel was to seek some substance which especially absorbed in the yellow, and at the same time acted as a sensitiser by fixing the free bromine liberated by the action of light upon the silver bromide. Both these ends are fulfilled by the coal-tar colour known as *coralline*. A plate dyed with this substance and exposed to the spectrum exhibited two maxima of photographic action, one the ordinary maximum in the indigo (near G), and the other, almost as strong, in the yellow, thus affording complete confirmation of Dr. Vogel's views. Aniline green* was next tried. This dye is stated to absorb the red rays, and a corresponding increase of sensitiveness for the red rays was observed, the photograph again presenting two maxima of activity, the one in indigo and one in the red coinciding in position with the absorption band of the dye. Thus Dr. Vogel's results may be summarised by saying that a dyed film of silver bromide exhibits maxima of sensitiveness in those regions where the colouring matter exerts its maximum of absorptive power, but the precise conditions under which these results can be obtained must be considered at present as unknown, since many observers in repeating the experiments, among others Dr. Van Monckhoven,† have failed to obtain other than negative results.

---

* *Poggendorff's Annalen*, vol. cl., p. 453.

In a communication made to the French Academy on the 27th of last month, however, the well-known physicist, M. Edm. Becquerel, stated that some experiments made at his instigation by M. Deshaies at the Conservatoire des Arts et Métiers had been productive of positive effects, and that some of Dr. Vogel's results with coralline and aniline green had been reproduced. M. Becquerel, however, does not confine himself to bromide films; similar results have been obtained by iodised collodion in which coralline was dissolved. A most remarkable action was observed also in the case of chlorophyll when this substance was used as a tinctorial agent. Although the collodion possessed only a faint green colour from the dissolved chlorophyll, the spectral image was of a much greater length than when plain collodion was used. Under these last circumstances the spectrum extended from the ultra-violet to between G and F, with the usual maximum of action near G, while with chlorophyll the region of strongest action extended from the ultra-violet to the line E in the green, and at the same time a weaker but yet distinct impression extended from E to beyond B in the red, with a strong band between C and D. By a close examination of the spectral image a second band of less intensity could be detected on the least refrangible side of the band between C and D, and other still weaker bands appeared in the green. The most striking confirmation of Vogel's results is to be found in the fact, observed by M. Becquerel, that the band between C and D *corresponds in position with the characteristic band of the absorption spectrum of chlorophyll dissolved in collodion.* The same results were obtained by M. Becquerel with every plate tried and with collodions containing different quantities of chlorophyll.

It must be admitted, then, that a film exerting selective absorption in intimate contact with a sensitive film of silver bromide or iodide affects the latter in those parts of the spectrum where the selective action is taking place. Here surely is a wide field for investigation, and one the importance of which will be at once obvious to the physicist. Practically also, when the precise conditions of action are made known, valuable results may be anticipated from the application of this principle to science and to art. Since the year 1842, when M. Becquerel photographed the whole solar spectrum from the extreme violet to the extreme red, and when Dr. J. W. Draper photographed the violet, blue, and extreme red, no successful attempts have been made to imprint the least refrangible end of the spectrum; and this, when we consider the great importance that the study of the solar spectrum has assumed of late years and the painful or even dangerous character of prolonged eye observation, is to us a matter of wonder. M. Becquerel's result, it will be remembered, was obtained by a film of silver iodide, first insolated or exposed to diffused light and then to the action of the spectrum. Here again is another question—the precise action of *insolation* on sensitive plates—demanding explanation at the hands of the physicist. The practical aspect of Dr. Vogel's discovery need not here be discussed at length. Attention may be called to the well-known difficulty of getting reds or yellows to imprint themselves in portraiture, a difficulty which now bids fair to be overcome.

Then again, in what we must consider as a higher sphere of practical utility, great advantage to the study of solar physics is likely to accrue. In point of fact the photographic method of comparing spectra described in a recent communication to the Royal Society now becomes available for the whole extent of the solar spectrum, and our knowledge of the true composition of the sun will be thus in course of time recorded permanently on "that retina which never forgets."

Great results have already been achieved by photography, and greater may be looked for. It must not be forgotten that in this most interesting branch of chemical physics we are in a period either of provisional hypothesis, or, worse still, of no hypothesis at all, so that valuable additions to our knowledge of physical and chemical laws should be forthcoming. The changes wrought by a beam of light on sensitive surfaces are sometimes physical and sometimes chemical. We may appropriately recall here the fact that mechanical pressure upon a sensitised surface of a silver salt acts in the same manner as a ray of light, giving a dark stain under the action of reducing agents. The experiment of Grove also, in which an electric current is set up by the incidence of a beam of light upon a prepared Daguerreotype plate, should not be forgotten. The equivalence between light and the other form of force has not yet been established, and it may not be going too far to conjecture that thermodynamics may possibly in the future have to appeal to the action of light upon a photographic plate. In the meantime we look forward to the promised continuation of Dr. Vogel's researches with no little hope.

R. MELDOLA

---

* The green referred to is probably that known as "aldehyde green." The so-called "iodine green," as I have frequently observed, *transmits* a band in the red

† *Photographic Journal*, No. 25, June 20, 1874.

LADY BARKER'S "LESSONS ON COOKING"

First Lessons in the Principles of Cooking. By Lady Barker (London: Macmillan and Co., 1874).

IN this little volume the authoress has proved beyond all manner of doubt how completely she is the right woman in the right place. Surely nowhere could the Committee for the National Training School for Cooking have found a lady superintendent better fitted than Lady Barker to put life and spirit into the scheme which they advocate, or one more thoroughly qualified to train and marshal the feminine bands that are now being drilled under her supervision in the South Kensington Schools of Cookery to invade and revolutionise the kitchens of the future in every part of the empire.

In the introductory chapter of her "First Lessons in the Principles of Cooking" the author at once grapples with the chief difficulty of the question at issue, and admitting the fact that fuel and food cost nearly twice as much as they did ten years ago, she tells her readers that this is precisely the reason why it has become the imperative duty of every mistress of a house, and indeed of every member of the community, to learn how materials for warmth or cooking may be made to go twice as far as they have done hitherto. And it is this problem which she here attempts to solve by help of her own practical experience, which was gained in that best of all training-schools, the school of necessity, as it existed in earlier days in the colony in which she learnt her first lessons of cooking. The theoretical knowledge of the "why" and the "how" has, as she informs us, been a far more recent acquisition in her case; but it is evident from the manner in which she discourses on the chemical composition of different articles of food, their various assimilative and other properties, and the confidence with which she tests, by the laws of science, every function of her ovens, pans and kettles, that she has mastered the scientifically theoretical branches of culinary knowledge as successfully as, in bygone times, she overcame its empirically practical difficulties.

Her lessons on baking, roasting and frying, boiling and stewing, and her remarks on fuel and fire, and on the advantages, economical and others, of cleanliness, are so sensible that we may commend them to the careful study of all housekeepers, young and old, who are actuated by the laudable ambition of combining economy and comfort downstairs, with good digestion and its concomitant, good humour, upstairs. When we say that Lady Barker is actually aiming at the daring innovation of making thermometers and "friometers" as indispensable to the cook as the compass is to the helmsman, we need expatiate no further on the debt of gratitude due to her from all long-suffering payers of heavy coal and meat bills. It might be supposed that Lady Barker's book was intended solely for her own sex, but this is not the case; for, more widely expansive in her desires than Mr. Ruskin, who wishes to see "every girl taught at a proper age to cook all food exquisitely," she considers that "a knowledge of cooking is every whit as necessary for a man," although she would not insist, in his case, on anything beyond the simplest forms of the art; and she evidently hopes to see the day when boys and girls will compete together for prizes in the National Cooking Schools. More practically important and worthy of serious consideration is the strongly expressed conviction that "no schoolboy ever gets as much nourishing food as he requires, and that this is the secret why boys of fourteen or fifteen years old scarcely ever look anything but thin and pinched." Furthermore, she wishes their parents and schoolmasters to understand that if they desire to see boys with clear complexions, bright eyes, and active limbs, "every game of football and cricket and every sharp run across country on a paperchase ought to be followed by a hearty meal of good beef or mutton, and not merely by weak tea, poor milk, and bread and butter."

The author's experience of the enormous amount of meat—uncontaminated by stimulants, it must be remembered—which growing boys and young men consumed in New Zealand in the early times of the colony, has also led her to form the opinion that, in spite of all tables and dietary reports, our soldiers and sailors are not allowed food enough for healthy men with good appetites. This, however, is a point that we must leave her to settle with her Majesty's Inspectors of military and naval affairs, to whose notice we would strongly commend her book, as well as to that of all other persons interested in the practical and economical bearing of the relations existing between the consumption of food and of fuel, and the hygienic condition of the consumers. It is quite certain, however, that until the general masses—and consequently all those who have hitherto monopolised the direction and practice of cookery—shall become better acquainted with the ordinary laws of physiology and chemistry, it will be hopeless to look for any radical improvement in the manner of using food and fuel to the best advantage in our households. Hitherto our kitchens have been managed haphazard, without system; the time for allowing such a wasteful condition of things to continue undisturbed is evidently drawing to a close. High prices and diminished supplies require to be met by a new system, based on true scientific principles; and considered from this point of view, we think that this little volume may fairly claim to be considered as supplying the thin end of the wedge, and indicating the manner in which the questions of practical cookery will in future have to be considered.

MAUNDER'S "TREASURY OF NATURAL HISTORY"

The Treasury of Natural History. By Samuel Maunder. Edited by E. W. H. Holdsworth, F.L.S., F.Z.S. (London: Longmans, Green, and Co., 1874).

THERE are few tasks more thankless and disagreeable than that of having to re-edit an encyclopædia or a dictionary, especially when it relates to a subject like Zoology, which is still so much in its infancy. A "Treasury of Biography," or a "Treasury of Bible Knowledge," in each fresh edition cannot, from the nature of its contents, need much modification; the manner in which the points that are dealt with have become stereotyped on the minds of mankind at large, makes the same operation having been performed on the letterpress a comparatively unimportant drawback to its reappearance in a form which will not be considered antiquated. This is far from the case in a work like the one we are now noticing. The spirit of biological thought changes as rapidly as fresh facts accumulate. The introduction of an all-embracing hypothesis, like that of evolution, shakes previously accepted theories to the foundation; long-known facts are looked at in quite a different aspect to that in which they were received before its introduction, and their relative value is differently estimated.

How then can it be expected that a zoological work, originally written when Cuvier's celebrated "Regne Animal" was the latest text-book on the subject, could be so modified by an editor, however able, as to make it at all a representative of the present state of biological knowledge? To do so the article on the "*Pachydermata*, an order of Mammiferous quadrupeds distinguished by the thickness of their skins," would have to be removed; that on each of its component genera re-written, and the word itself obliterated from the whole work. A similar operation would have to be performed on many of the larger orders; and to such an extent would this process have to be carried on, that it would soon become doubtful whether a new work instead of a fresh edition would not be the more economical as well as the more useful.

This being the case, we are not surprised when we find that nothing more is said of the affinities of the Echidna than that "it has the external coating and general appearance of the porcupine, with the mouth and peculiar generic characters of the ant-eaters;" whilst the word "monotreme" is only mentioned in the second supplement. In like manner we notice that the Dugong and Manatee are said to rank among the Cetacea; whilst the Sirenia are omitted except in the appendix. The word "Chevrotain" refers us to "Musk Deer," thus perpetuating the well-known error; and, on finding it, we are told that there is a Javanese Musk deer (*Moschus javanicus*) rather larger than a full-sized hare, at the same time that "there are other musk deer, which are very small, and to which the general term of *Chevrotains* is given; they are inhabitants of Java, Sumatra, Ceylon, and Southern India." The genus "Ammocetes" has not been removed, and is still said to be "a genus of Chondropterygious fishes, allied to the lampreys," instead of the young of the lamprey, which it has for some time been known to be.

The creatures most fully treated of are the birds, the best known of which are described with fair completeness, with extracts from the works of Mr. Gould and other observant naturalists, as to their habits and coloration. We do not know why the Poe Honey-eater (*Prosthemadera concinnata*) is described both under its English and Latin name, in the same way that it is difficult to account for the Orycteropus and the lady-bird being each represented twice by woodcuts.

Several of the original articles are lacking in important detail. Of the Ammonite and Orthoceras it is only said that they are genera of fossil shells, which leaves their affinities unnecessarily vague. So there is not much to be learnt from the observation that Nummulites are "small round fossil shells, which in various parts of the world are found in immense numbers."

Mr. Holdsworth adds an extra supplement, which contains much useful information of recent origin. It includes an account of the breeding of the hippopotamus and of the Sumatran rhinoceros, specimens of both of which have been born in this country during the last two or three years. The Liberian, or Lesser Hippopotamus, is also described, as is the new Bird of Paradise *Drepanornis d'albertisi*, obtained from New Guinea by Signor d'Albertis, and named by Mr. Sclater. An account is also given of the nesting of the crocodile in Ceylon, and of the incubation of the python.

This second supplement also adds to the palæontological information contained in the first, by giving a description of the *Dinoceras mirabilis* of Prof. Marsh, from Colorado; of *Archæopteryx lithographica*, of the other Odontornithes, and of *Odontopteryx talipoica*.

Notwithstanding the imperfections we have pointed out, there is much information to be obtained from this work, and which can be obtained from it more easily than from any other, on account of its being arranged alphabetically, and from the succinctness of the articles.

OUR BOOK SHELF

The Amateur's Photographic Guide Book. Being a complete *Résumé* of the most useful Dry and Wet Collodion Processes, especially for the use of Amateurs. By W. J. Stillman. (London: C. D. Smith and Co.)

ALTHOUGH we already possess numerous books of this class, the present little volume will doubtless meet with a welcome from amateur photographers, coming as it does from the pen of one well known to be a thoroughly practical worker. The book is small (numbering only 92 pp.), but contains sufficient information for those who desire to master the dry and wet collodion processes. Indeed, more pretentious works on photography which have come under our notice contain a large amount of what we are inclined to regard as utterly superfluous matter, and it is, moreover, refreshing to open a "Guide" which is not made a medium for some dealer's price-catalogue. The present work consists of three chapters and six appendices. The first chapter treats of cameras, and describes the process of taking pictures by the dry-plate method; some useful hints will be found in this chapter by outdoor photographers. The second chapter describes the ordinary wet collodion process—a process which has been so often described before, that Mr. Stillman has little to add by way of novelty; while the third chapter is devoted to positive prints. In the appendices we have special remarks on baths and bath solutions, on cleaning plates, on developers, on dry processes, &c. On this last subject, by the way, we notice that the decimal point has been omitted from several of the numbers in the formulæ, and although these are doubtless typographical errors, the figures as they stand will be apt to mislead beginners: "Sulphuric acid 1840," for instance, would at first sight lead the uninitiated into the belief that an acid in bottle since this date was necessary for success in making pyroxyline, whereas the author only means an acid of sp. gr. 1·840.

On consulting books on practical photography, anyone who pretends to any knowledge of chemical science cannot fail to be struck by the empiricism of the various formulæ proposed, and a feeling akin to regret is experienced on reflecting that this fascinating and useful art has reached its present state of perfection by processes which have been essentially methods of trial and error. The large numbers of practitioners, both professional and amateur, now engaged with this subject ought surely to produce from their ranks investigators willing, as we know they are able, to take up the purely scientific aspect of the subject. The harvest reaped by such an investigator would surely repay him, for we are of opinion that in the theory of the sensitive film lie hid some of the fundamental truths of molecular physics. R. M.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Woolwich Aeronautical Experiment

I HAVE read, not without some surprise, the accounts given by the daily papers, stating that the recent experiment at Woolwich had been fruitless. The lessons of the experiment are numerous, although it would have been easy to predict all that happened; but the impressions relating to balloons and ballooning are generally so vague and so incorrect, that I may be justified in trying to summarise the results which were obtained in connection with the siege of Paris, which might otherwise be lost altogether.

As I stated in my article on the "Flying Man" (vol. x. p. 230), the principal object to be considered in the theory of aerial motion is the friction of the moving surface against the air; the friction increasing according to the square of the rate of motion v^2, the force necessary to move the body at a certain rate varies according to v^3. Consequently it is easy to impart a small motion to a balloon; but the difficulty very quickly becomes insuperable except with an almost inexhaustible source of power, such as a powerful steam-engine. *Hand-power cannot be made of any avail;* M. Dupuy de Lome's experiments proved this definitively, and that question must be considered as settled in favour of *steam-power*.

The problem now at issue is to ascertain whether it is possible to construct a *safe* fire-engine balloon, and to use it successfully for travelling to a distance. But I shall give some calculations on the recent experiments with hand power.

If we suppose that the motion of the directing balloon is uniform, the friction consumes all the force which is generated;* consequently, if n = number of men pulling the fan, m = the real motive power generated by each man, k = a coefficient which depends on the nature of the surface of the balloon, l = great axis of balloon, r = radius of equatorial section, v = rate of motion—I suppose that r was the same for Dupuy de Lome as for Bowdler, and that M. Dupuy de Lome's great axis was $2r$, his number of men twelve instead of two, and his rate of motion 9 ft. per second—we shall try to find what ought to be the motion of Bowdler's balloon.

As according to the principles of mechanics

$$v = \sqrt[3]{\frac{n.m.l}{k r^2}}$$

it is easy to find

$$v^1 = \frac{3}{\sqrt[3]{6 \times 2}}$$

under these circumstances. But m is not the same, as Dupuy de Lome's men were pulling on a large screw acting without any transmission; Bowdler's apparatus was a small screw 3 ft. in diameter. I suppose Bowdler's utilisation was only half of Dupuy de Lome's; consequently the real equation is

$$\frac{v^1}{v} = \frac{1}{\sqrt[3]{6 \times 4}} = \frac{1}{\sqrt[3]{24}}$$

not far from ⅓. The motion of Bowdler's balloon could not be more than 3 ft. a second.

It was impossible for Major Beaumont to see any difference with the motion of the air being at a distance from the earth. It could be ascertained with very great difficulty even with an aeronautical compass of the best description.

But the fact of the balloon having been put into a state of rotation by the rudder is a demonstration of the fact of a differential motion having been obtained. It is the very pressure resulting from the differential motion which is the only force that rotates the balloon in acting on the rudder. The rudder is pushed as it is in the sea when the ship is acted on by sails or steam, and in the air the action is very easy, as the balloon is almost symmetrical around its vertical axis.

It is true the governing power could be imparted very easily by direct action on an excentric helix adjusted for the purpose, as has been suggested, but not tried, so far as my knowledge goes. I will say the same of the vertical motion, which is very important also for ballooning; but the theory being a little more complex, I shall keep it in reserve for a future communication.

The rotatory power is of importance in making observations in the air, and it is praiseworthy in Major Beaumont and Mr. Bowdler to have directed their attention to that particular point.

The abstract principles of aeronautics have been pretty well ascertained, but the practice is a very difficult thing, and can only be tested by a series of experiments. With such an experienced balloonist as Mr. Coxwell, and the resources of an enlightened Government like that of England, it seems likely that such experiments will be tried more easily than in France. Under the present circumstances, I think it is our duty to assist you so that you may derive benefit from the knowledge we bought so dearly amidst our great national calamities.

W. DE FONVIELLE

---

* I speak only of the motion in still air.

Fogs, Field-ice, and Icebergs in the Atlantic

THREE unwelcome phenomena have this year, in more than an ordinary degree, vexed the coasts of the United States and the navigation of the Atlantic; I allude to fogs, field-ice, and icebergs. The first have so much interfered with the success of the Nantucket fishermen that but few mackerel have been caught by the seine, the schools cannot be followed, and the boats have frequently remained idle for days. No one who has not met with these fogs can form an idea of their density. With a bright sun shining over head, objects cannot be discerned at the distance of 100 ft. Collisions have been numerous in all the great American ports and rivers. On one occasion hundreds of tons of cargo remained two days in New York before it could be transported across the Hudson to Jersey city, although the distance was frequently under a mile from wharf to wharf.

At sea these fogs have extended almost without a break for 1,600 miles, the wind being from east, through south, to west. When sounding the steam whistle I noticed, what has probably been noted before, that the denser the fog the greater were the reverberations, and that the echo was always heard to windward as plainly as if it were deflected from a cliff in that direction. I presume that this arose from the resistance the waves of sound encountered in travelling against the wind, none being heard to leeward. These fogs are attributed to the great difference which exists in spring and summer between the temperatures of the air and water. Having, however, often remarked that they come when these conditions are not found, I am induced to believe the cause must often be looked for in the atmosphere alone, by the mixture and condensation of the different strata of air there. At times these fogs are in streaks, and the alternations of heat and cold, as they sweep by, are very noticeable. Now, if the sole cause were due to a simple difference of temperature between the air and water, I cannot understand why this should be, unless the sea was composed of similar streaks of hot and cold water, which here is not the case.

In the Atlantic, seamen were astonished to find that early in February field-ice and bergs had reached the parallel of Cape Race, and have since been seen as far south as 42° N. lat., drifting to the north-east in the heated waters of the Gulf Stream. Two steamers and an equal number of sailing vessels are known to have been seriously damaged by colliding with them; and the wonder is that so few accidents have taken place when it is borne in mind that for hundreds of square miles the steam and sailing tracks between America and this country are dotted with them. A few of the bergs have been supposed to be three miles in length, and on two occasions steamers passed through or around ice-fields 100 miles in length. It is also alleged that another was stopped five hours by field-ice so far south as the forty-third parallel.

There is a general belief that the vicinity of ice may be readily detected by the fall in the temperature of the water. Unless it be in very large masses, and the ship close to, this test is not of much value, owing to the natural law which causes a cold surface fluid to sink until equilibrium is restored. A better test is the cold, damp feeling of the air, but this is only noticeable when to leeward of the berg or field, and is practically of no value, as the wind passing over the sea-water at 28° will cause a similar sensation. In some states of the atmosphere the clouds near the horizon assume a peculiar grey tint when the ice-field is of large dimensions.

Unless the weather be very foggy, an iceberg is easily distinguished on the darkest night at a considerable distance by the light reflected from it, and to this cause I attribute the great immunity of ships from accidents. Ordinary islets dropped in the Atlantic would cause an infinity of wrecks, owing to the absence of this useful property. When an iceberg reaches a low latitude it loses much of its beauty; the brilliant white and prismatic colours which it had in the north disappear, and the whole mass, except under peculiar circumstances, looks like a mountain of soda. At rare intervals, however, during a gorgeous sunset, the tinted clouds are reflected on its sides, and their various colours flash across like the shades of a rich shot silk, but infinitely more beautiful, eliciting terms of admiration alike from the sentimental dandy or the rough emigrant.

The cause of their early appearance so far south this spring is a mystery; many attribute it to a mild season. As I have before stated, I cannot concur in this opinion. No man can with certainty assert that in the Arctic regions a January temperature can cause the fracture of such masses from their original beds.

Celtic, July 28 WM. W. KIDDLE

Science at Cambridge

IN an article on the Public Schools Commission published in NATURE (vol. x. p. 219), the following passage occurs:—"Now it is acknowledged on all hands that the teaching of a subject at school and its recognition at the universities are inseparably connected, and especially with regard to science. The Colleges say, We cannot give more scholarships, because a sufficient number of men of good attainments do not present themselves; and the Schools reply, We cannot spend our time on subjects for which there are so few rewards. Both profess willingness, but each calls on the other to take the initiative." It is implied by this that the schools and universities each shelter themselves in their conservatism by throwing the blame on the other. With respect to the University of Cambridge, at least, I think this is unfair. King's College offered scholarships (of 80*l.* a year for three years) for natural or physical science in the years 1872 and 1873; on both occasions the examiners (who were in no way connected with the college) reported that no candidates of sufficient merit had presented themselves. At length, in the present year, they have awarded a scholarship in these subjects.

Everyone who is conversant with Cambridge knows that the colleges are *anxious* to reward proficiency in science, and that the tendency is distinctly to award scholarships therein on easier terms than in other subjects, but that there is a dearth of candidates. Although the valuable science scholarships at Trinity have always been open to members of all colleges of either university, the number of those who have tried has always been very small.

I maintain, then, that Cambridge *has* taken the initiative as far as it is desirable to do so. It would be a lamentable thing to award prizes too profusely, as we should thereby be stocking the University with an inferior staff of teachers, who would transmit their inferiority to the succeeding generation.

GEORGE DARWIN

Trinity College, Cambridge, July 30

Circulation of Apparatus and Scientific Works

THE letter of Mr. H. W. Lloyd Tanner (NATURE, vol. x. p. 244) has opened up a subject of importance to all science teachers, and surely there are no insuperable difficulties in the way of the Kensington authorities sending out for loan, under proper conditions, apparatus and scientific works. Already there are loan collections of apparatus to be obtained from South Kensington by any recognised science class, but the cost of getting up and sending them out must be far greater than necessary. We were much amused last winter by receiving from the Department of Science and Art, as a loan, *five* huge boxes of elementary chemical apparatus. When these were opened we were quite disappointed, for only a few pieces proved useful in our class. We did not want a lot of big bell jars, glass retorts, Florence flasks, and bits of glass tubing stuck through wretched corks. Anyone can easily understand that it is simply waste of money to send to a science class apparatus on loan that the class already possesses. Why are not teachers allowed to choose the apparatus? In furtherance of the object mentioned by Mr. Tanner, may I be allowed to offer the following suggestions:—

1. That a collection of scientific apparatus and standard works for loan be made at Kensington.

2. That science teachers desirous of using books and apparatus pay a subscription, say, of 10*s.* per annum.

3. That lists of apparatus and books be published, and sold to subscribers at a reasonable figure.

4. That books and apparatus (from list) be lent for a term to subscribers (subject, of course, to conditions of return in good order).

5. That the Department pay the carriage to and from Kensington.

Perhaps other readers of NATURE will kindly give further suggestions.

To such as myself, anything like the above would be a boon indeed. Living in a small country town in which there is neither public reading-room nor library, and being daily engaged in teaching science, and, withal, intensely fond of the study of it, I am thrown almost entirely upon my own resources to provide scientific books and apparatus. Yet I am better off than numbers of science teachers. The trustees of our schools have lately granted 5*l.* a year for scientific apparatus, and to this we get the Government grant of 50 per cent. added. Further, I can at any time borrow a good microscope, and have access to several private libraries belonging to gentlemen of scientific tastes. Still, frequently, the very information wanted is not to be obtained, and I for one should be glad to avail myself of any scheme like the one I have suggested.

Dunstable A. P. W.

Sounding Flames

IN the summer of 1842 I attended the lectures of Dr. William Reid, brother of Dr. David Boswell Reid, the celebrated ventilator of the House of Commons, in the great barn-like classrooms of the latter chemist. In the practical class we produced sonorous flame vibrations in iron tubes three or four inches in diameter and about 2 ft. long, held over similar tubes covered with wire gauze. These instruments were the property of Dr. D. B. Reid, and produced a noise like the roar of a lion.

Edinburgh, Aug 7 T. STRETHILL WRIGHT

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THIS Association, as we have already intimated, meets at Lille on Aug. 20, and thus its meetings will be held contemporaneously with those of the British Association; this is perhaps to be regretted, as some of the members of the two Associations might wish to attend the meetings of both. The Lille session promises to be as brilliant as either of the two preceding ones. The proximity of Lille to Paris is very likely to attract a greater number of members than was gathered at Bordeaux or Lyons. A considerable number of foreigners have promised to "assist" at this year's meeting; among whom we notice the names of Prof. Sylvester and Dr. Odling.

The session will be opened at three o'clock on the afternoon of the 20th, by the inaugural address of M. Wurtz, the president for 1874, and also by an address by Lieut.-Col. Laussedat, Professor at the Conservatoire des Arts et Métiers, general secretary of the Association for 1874. There will, of course, be the usual sectional meetings, and several public lectures have been arranged for. Excursions always form an important part of the proceedings of the French Association, and three have been organised for this year; the first excursion, on Aug. 23, will be to Boulogne; the second on Aug. 25, to the coal-mines of the "Compagnie d'Anzin;" the third excursion commences on the 28th, after the conclusion of the meetings, and will probably be to Brussels and Anvers, lasting several days.

To show the magnitude to which this Association has already attained, we may state that about 150 names are down as readers of papers in the various sections, several of whom are to read more than one paper. M. Cornu is to describe a new optic spherometer. Several papers are to be read by M. Marcel Deprez on improvements in electrical appararus and on certain theoretical aspects of steam-engines. Prof. Giard, of Lille, is to make several communications in Zoology, and M. Hamy in Anthropology; Prof. Houzeau, of Rouen, is down for a paper on Concentrated Ozone; and M. Lallemand, of Poitiers, will describe his researches relative to the Diffusion of Light. M. G. Lemoine will read two papers, one on researches in Chemical Mechanics, and the other on Equilibrium in Gaseous Systems. Prof. Terquem, of Lille, will read various papers in Optics and Acoustics, and M. G. Tissandier will give a public lecture on Meteorology and Balloons.

On the whole, there will be a fair number of purely scientific papers, though there is an unusually large proportion in medical and industrial subjects.

THE COMETS

THE following communication appears in the *Times* from Mr. J. R. Hind, F.R.S., dated Mr. Bishop's Observatory, Twickenham, August 10 :—

"I send you positions of the last new comet (Borrelly) for the ensuing ten days ; warning the amateur, however, that he must not expect to see it well without a very good telescope. They are deduced from the following orbit, which I have calculated from the first accurate observation at Marseilles on July 26, one at Strasburg on Aug. 1, received from Prof. Winnecke, and a third taken at Mr. Bishop's Observatory on the 4th :—

"Perihelion passage, August, 27·0861 Greenwich time; longitude of perihelion, 344° 24′ 6″; ascending node, 250° 59′ 50″; inclination to ecliptic, 41° 39′ 52″; distance in perihelion, 0·98090 ; heliocentric motion, direct.

"The subjoined places are for midnight .—

	Right Ascension. h. m. s	Polar Distance. ° ′	Distance from Earth.
Aug. 10	14 33 22	20 40	0·676
,, 12	14 20 44	19 47	0·684
,, 14	14 7 27	18 59	0·692
,, 16	13 53 22	18 15	0·699
,, 18	13 38 18	17 36	0·705
,, 20	13 22 28	17 2	0·711
,, 22	13 5 55	16 34	0·717

"The distances are expressed, as usual, in parts of the earth's mean distance from the sun.

"It appears that efforts in various observatories to obtain a daylight view of the late bright comet have been fruitless. I had been most hopeful of it being thus seen with the powerful telescopes and in the favourable climate of Marseilles; but I learn from M Coggia that a close search for the comet in fine skies on July 22, and from morning to evening on the 26th, failed to afford a glimpse of it. At Twickenham, under very advantageous circumstances, about noon on July 23, we could not detect it, when Procyon, the principal star in Canis Minor, at nearly the same angular distance from the sun, was shining brightly in the telescope. It affords additional evidence that proximity to the earth is not so important a condition for visibility of a comet in the daytime as close approach to the sun; but it was very desirable to have the appearance of Coggia's comet upon record."

THE FORM OF COMETS*

IV.

WE have seen then that the phenomena of the tails of comets can be explained even including their most complicated appearances. I now proceed to deal with other phenomena, for the best proof of the truth of a theory is its capacity to explain a multitude of details which were not at first considered. Examine in the figure (Fig. 8) which I recently showed you of Donati's comet, that singular dark portion which is seen in the axis of the tail to a very considerable distance from the nucleus, and say if that cylindrical space, void of matter, is not the effect of the interposition of a screen—the nucleus, which intercepts the repulsive force, and suppresses in this region all the molecules driven from the head of the comet. This is because the repulsive force, being a surface-action, is spent against that of the nucleus, and is arrested by this simple screen ; it is quite the reverse of attraction, which acts effectually through all matter as if that matter did not exist. This cannot have been the shadow thrown by the nucleus, for two reasons, of which it is enough to mention the first : the black streak, besides being much too long, is not in the exact direction of the luminous ray ; it is inclined to the radius vector at an angle of several degrees, for which the theory accounts. In short, it widens considerably when tails almost straight, composed of the rarest materials, are about to disappear, and we can often follow its trace to the extremity of the tail.

But I must dwell, in conclusion, upon the curious phenomena of the head and upon the luminous sectors which usually appear in the direction of the sun. We find here a new confirmation of the play of the repulsive force. Fig. 15 is a drawing on a large scale of the head of the comet of 1861, made at Rome by Father Secchi.

Let us not forget, in what follows, that one of the characteristic features of the nebulous layers which surround the nucleus, and of which it is perhaps entirely composed, is the transparency which permits us to see small stars through depths much greater than that of our atmosphere. There is reason, then, for believing that the solar rays penetrate across these layers to the central nucleus and heat it, all the more since these same layers are probably not so permeable to dark heat as they are to luminous heat. In the space of three weeks the central heat may thus be raised from the degree of heat of distant space to a temperature sufficiently elevated to volatilise a part of the matter of the nucleus, and perhaps promote chemical reactions arrested till then by the original cold.* Under this increasing influence the matter is dilated and rapidly separates from the nucleus (19 metres per second for Donati's comet); but soon this matter, still too dense to be sensibly repelled, reaches the surface limit beyond which it ceases to belong to the comet. This surface limit presents, as we have seen, two opposite conical points by which the emission takes place. At a later period this matter getting further and further away, and becoming more and more rarefied, falls under the action of this repulsive force, which then makes it turn tail and fly to the rear. This species of conical envelope, turned towards the sun, assumes the appearance of a calyx with inverted edges, while the opposite envelope with obscure interior contracts under the influence of the same action, but without changing its curvature. There will be noticed, in front of this species of calyx, exterior strata nearer to the sun, to which they present their convexity instead of being opened out conformably to the theory which M. Roche had hitherto based solely upon attraction. I asked M. Roche to introduce the new force into his investigation of the surfaces assumed by a fluid mass submitted to the double attraction of its own mass and of that of the sun, and we have had the satisfaction of seeing one of the two singular points of the surface limit disappear. The surfaces are completely enclosed and become curved towards the sun; there is no room on this side for any loss of matter. But this is to be expected in the exterior layers, which have too little density to obey repulsion; while in the interior of the head, very near the nucleus, attraction still rules exclusively on account of a density still very great.

In order to render these somewhat complicated details of the theory intelligible, we have only to turn round on its axis Fig. 16; it will generate a surface of revolution composed of an exterior envelope having a form roughly parabolic, and of two envelopes attached to the nucleus, one of which is, to use a botanical term, of a cyathiform aspect, while the other is almost conical.

---

* Continued from p 270.

* Spectrum analysis seems to prove that this heat may reach the point of giving to the nucleus a light of its own, presenting, moreover, the characteristics of a light emitted by a gaseous substance. But up to the present time (1870), indications of this kind are too vague and too doubtful to enable us to derive much help from them

If we compare this theoretical figure with that of the head of the comet of 1861 (Fig. 15) and of other comets, it will account for the transparency of these surfaces and for the effects of perspective. The latter are continually changing, for comets are presented to us in all imaginable positions.* The conical anterior envelope is often described by observers under the name of a luminous sector, a term which gives a false idea of its real form. In the head of Donati's comet, the luminous sector appears to have had an amplitude very much greater than that of the comet of 1861.

You see that all the most constant, the best investigated, the most characteristic details of the figure of comets agree in disclosing the action of a repulsive force which is exerted by the sun not in virtue of his mass, but in virtue of his superficial incandescence. Extinguish the photosphere of the sun, reduce it in thought to the state of crust to which cold has long ago brought the earth, so as to leave nothing more than the solar attraction inherent in its mass, indestructible as the mass itself, and you will suppress at the same time the gigantic tails of comets and the cup-shaped emissions of their heads. They will no doubt still lose some part of their materials in approaching the sun, but these materials will be disseminated along the orbit of the comet instead of flying away from the sun into space with an incredible swiftness. In a word, comets would lose the forms represented in Fig. 7, and would assume those of Fig. 6.

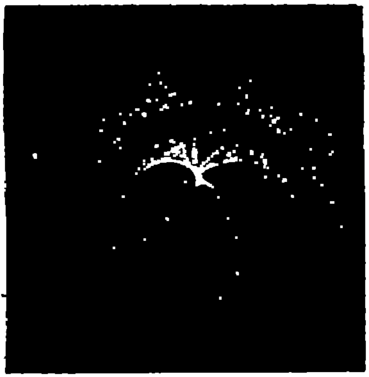


FIG. 15.

It may perhaps appear to you singular that we must go to celestial phenomena for evidence of the existence of a force so widespread as repulsion due to heat when it acts at a sensible distance, and not from molecule to molecule. In reality there is nothing astonishing in this; it was the same with attraction.

Each of you is firmly convinced of the existence of this force; you know that two spherical bodies attract each other in proportion to their mass, and in inverse proportion to the square of their mutual distance, and that notwithstanding that you have not had ocular demonstration, that you have not tested it by experiment; around us, within us, nothing announces to us that bodies attract each other. No direct experiment has ever been made on the point in France, and if any physicist set himself to it, he would require six months at least to prepare for what is known in England as the "Cavendish Experiment."

But if attraction produces around us effects so feeble that no mechanician or physicist ever thinks of taking them into account in his experiments and calculations, on the other hand it acts on a grand scale in celestial space on account of the greatness of the masses. Well, it is the same with the force of repulsion; on account of the incandescence of the surface of the sun, of the enormous extent of that surface, and of the small density which matters may acquire, where they have infinite space in which to expand. Although this repulsive force is acting all round us, just like attraction, it is quite as difficult to prove it, because we cannot attain by means of our furnaces the degree of incandescence of the sun, and above all because we operate only upon insignificant surfaces, and because we work in an atmosphere of an enormous density as compared with cometary materials. It is easy to see, then, that to obtain evidence it would be necessary to resort to combinations as delicate as those of the Cavendish Experiment.

We may, however, do this: the repulsive force, with all the characteristics which we have discovered in it, is yet only a hypothesis which accounts at once for the figure of comets and for the acceleration of their motion. We have connected it, it is true, by the incandescence of the sun, with the familiar phenomena of the repulsion determined by heat between the molecules of bodies; but it remains to show, by a direct experiment, the difficulties of which we have seen, that this repulsion exists beyond the infinitely small distance which separates these molecules. This experimental verification of every hypothesis is an essential thing in astronomy; by this alone can our minds be fully convinced. The physicist, on the contrary, can use more largely the convenient artifice of hypotheses, since he holds in his hand, so to speak, the phenomena which he studies, may reproduce them, call them forth at his pleasure, and regard his subjects in all their aspects. Should an hypothesis be found to contradict certain facts, the physicist imagines for them another more comprehensive which he will subject to the same process. It is not so with astronomy. That which has long been wanting to the theory of attraction in the case of many minds strongly prejudiced, moreover, in favour of another doctrine, is precisely this direct and experimental verification the necessity for which I have pointed out. Everybody did not feel, on the appearance of the *Principia*, that it was implicitly contained in the famous calculus which enabled Newton to see that the force which holds the moon in its orbit is identical with that which every-

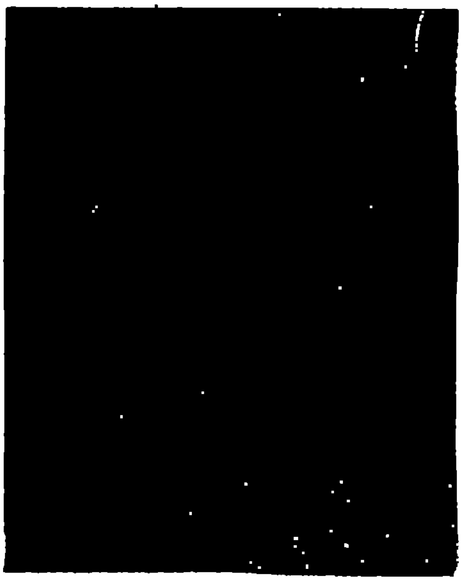


FIG. 16.

---

* Moreover, the least want of homogeneity in the nucleus and a rotatory movement may considerably modify the phenomena and leave only the narrow part of the anterior calyx. But these anomalies do not take away from the phenomenon its characteristic physiognomy, even when they give, for example, to the anterior calyx, a most curious radiated aspect.

where causes bodies to fall to the ground. The learned opponents of the doctrine on the Continent would, without doubt, have been favourably disposed to it before the experiment of Cavendish or that of Maskelyne, if Newton had been able to realise to them so as to show to all eyes that bodies of suitable form and of any nature whatever attract each other in proportion to their mass and in the inverse ratio of the square of their distance.

But how are we to apply the Cavendish balance to the measurement of the repulsive force of an incandescent surface? First of all, the materials of our apparatus are of a density enormously superior to that of comets; then it is necessary to operate in a perfect vacuum, for the least trace of air which remains in the apparatus will give rise to currents under the influence of a surface strongly heated, and will thus obscure the effect which we endeavour to establish. In trying to surmount this difficulty,* I have been led to think that if I could make an incandescent surface act upon the small mass of air itself which acts as an obstacle to us in the vacuum of our best pneumatic machines, I should obtain a very appreciable repulsion; only we must find some means of rendering this air visible. The artifice to which I am about to have recourse before you consists in illuminating this rarefied air by means of the spark of Ruhmkorff's induction apparatus. (See Fig. 17.) This glass bell-jar, in which a vacuum has been made, is traversed by the two conductors of the apparatus, the one vertical and the other horizontal. You see the spark spring out under the form of feebly luminous stratifications of a peculiar rose colour; at the same time the horizontal conductor is covered with a luminous sheath of a well-marked blue colour. It is the air which is thus illuminated by the passage of the current. Remark, however, the particular form of the horizontal wire; it is formed partly of a thin blade of platinum surrounded by a blue aureole. I shall redden this plate by means of an ordinary current, composed of several Bunsen couples. I cause this current to pass through the horizontal conductor, not disturbing in the least the first induction current. The platinum plate becomes incandescent, and you soon see the blue-coloured sheath separate from the platinum plate like two lips which are parted.

I have varied this experiment to obviate the objections to which the increase of the conductibility of the air might give rise; but it has always succeeded. Thus have I obtained an analogous repulsion by acting transversely upon the rose-coloured stratifications; the case was absolutely the same as if a perfect vacuum existed around the plate, a vacuum of definite limits beyond which the electricity would not pass, while an increase of conductivity would simply cause the induction-spark to incline towards the favourable region and so to modify its usual configuration.

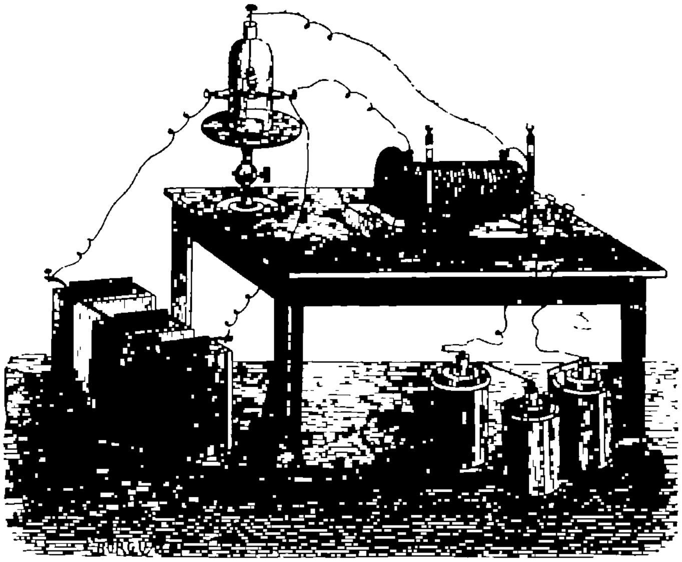


Fig. 17.

Thus have we been led to conclude with perfect certainty (1) that cometary phenomena reveal to us in the universe the existence of a second force totally different from attraction, capable of playing an important part and producing before our eyes gigantic phenomena; (2) with great probability, that this force is nothing else than the repulsion due to heat.

Perhaps we may come upon this force when we investigate more closely the strange phenomena of the solar protuberances which the brilliant discovery of Janssen and Lockyer permits us henceforth constantly to follow, or when science will be in a condition to approach the investigation of those mysterious star clusters which attraction has not been able to unite into a single sun, and which appear to us under forms so strange and withal so geometric.

Whatever may be the value of these experiments, it is of importance, I believe, to science, not to leave this beautiful question of the figure of comets without any other answer than the *je ne sais* of Arago, and it is of not less importance to natural philosophy to prove that the forces which rule the stars are none other than those which act around us at the surface of the earth. If it should displease any sage metaphysician that I have tried to establish a duality of forces in a region where he vainly flattered himself that unity reigned, I pray him to consider that, if it is possible to transform, so to speak, certain forces into each other, to produce, for example, heat by means of the concussion of a body acted *on by* terrestrial attraction, then electricity by means of this heat, magnetism by means of this electricity, and finally to attract a very peculiar sort of matter by means of this magnetism, we have not succeeded in the least in transforming the attractive force of the least molecule, since its weight remains invariable through all the modifications of the forces which act upon it. The desired unity, then, was far from being realised before the appearance of that repulsive force acting at a distance which the cometary phenomena definitely inscribe in the mechanism of the heavens by the side of attraction, and which I find around us in the phenomena of heat.

---

* We could assuredly manage it, but it would be necessary to have at our disposal means of execution superior to the resources of a private individual.

At all events, we have got a great way from that judicial astrology which I felt bound to remind you of at the outset, in order to show to you the condition in which we found that branch of celestial science. While, in planetary astronomy, scarcely anything has been done for two hundred years but to develop indefinitely the mathematical formulæ of a force established and defined, we have tried here to put ourselves on the track of a force which rules more especially the cometary world, and have endeavoured to give it a name.

THE AMERICAN OYSTER-TRADE

SOME notion of the extent of the trade in oysters at Baltimore may be gathered from a recent report of the British Consul. Baltimore, it is said, is recognised all the world over as the great centre for raw oysters—New York as well as the Southern and Western States depending on it for their supplies. The packing-houses in Baltimore have agencies in all the large cities and towns, and these agencies have sub-agencies covering the country districts. About twenty firms are engaged in the packing and distribution throughout the States of raw oysters, 5,000,000 bushels of which are annually consumed to meet the demands of the trade, which is one not only incurring great risks, but also requiring some tact for its successful management. Such is the perishable nature of the oyster that the risk in handling them has much to do in determining their price. Delays in the arrival of a vessel will often cause a whole cargo to become putrid, so that it has at once to be thrown overboard. To cover these risks the margin of profit is necessarily large. Large numbers of men, women, and children are employed in opening the oysters and removing them from their shells: for this work they receive 20 cents per gallon, and the average earnings of each person are about two dollars per day of ten hours.

In packing the raw oysters they are, after being opened, washed carefully, then placed in flat cans with a little fresh water, as the liquor or natural juice of the oyster decomposes in twenty-four hours after exposure. These cans are then packed in rows with cakes of ice between them, and shipped by express to their destination. At certain points it is arranged that these cases destined for the far west shall be opened, fresh ice placed between the cans, and then re-shipped to their ultimate destination. Oysters packed in this way and re-iced at certain places on the route can be sent from Baltimore to San Francisco in good condition. Besides this trade in raw oysters as many as 3,000,000 bushels are annually steamed and hermetically sealed in tins for shipment to all parts of North America and to Europe. The season lasts from Oct. 1 to April 1. By the steaming process the oysters are so preserved that after being sealed down they will keep good for an indefinite period of time.

RUDE STONE MONUMENTS OR CHAMBERED BARROWS

I.

THE object of the present and succeeding articles is to discuss some of the opinions which are held by some of the leading antiquaries of the present day with respect to the construction, destination, and also antiquity of these monuments, and to show that, notwithstanding all the advantages presented by the establishment everywhere of Archæological Societies, the publication of their journals, and the increased facilities for travelling, many professed students of this branch of science are still found to be blindly adhering to the views of antiquaries of the past century. There is a very remarkable contrast between the progress made in the study of unchambered, and in that of chambered, barrows. We have now a much sounder knowledge of the former than of the latter, not simply because the latter are more difficult to understand, but because their study requires qualifications not possessed by every investigator. He must have long acquaintance with the monuments, sufficient dexterity in drawing and surveying to make accurate plans, sections, and elevations, be a close and unbiassed observer, and then have leisure to devote his intelligence to the scrutiny. Cursory examination will be always fatal to the acquisition of sound knowledge, and serve to mislead others; and it is greatly to be feared that this has been too common a habit and result.

The first erroneous opinion to which attention is now directed is that very many of the cromlechs or dolmens (to employ terms which are in general use), *i.e.* rude stone structures which in the British Islands and on the Continent are partially or wholly exposed to view, were never in any other condition; that is to say, that although they may be in some measure dilapidated now, yet that they were originally intended to be exposed buildings. They are aware that many other structures of analogous forms are imbedded or enveloped in mounds so as to be invisible externally, but they will not allow that the exposed ones ever were so. As long as these authors confine themselves to the bare declaration of their belief their position is not so assailable; but when they point to the monuments which they say illustrate their arguments the case is altered. The examples are open to the inspection and consideration of everybody, and the accuracy of their descriptions can be tested. This has been done, and the result has been that numberless inaccuracies have been detected in the published accounts and in the plans; and the conclusions which have been deduced from them are consequently pronounced to be erroneous.

It will be sufficient to point out this in a few of the well-known monuments to which they have directed our attention; and as no author has treated the subject so comprehensively as Mr. Fergusson, or been so methodical in the arrangement and classification of the monuments, his recent work * will be particularly referred to in the following pages. He has admitted that he is indebted for much of his information to the published accounts of others. It must be premised that we do not assert there is positive *proof* of the former existence of the mounds, nor do we say that there is any tradition of them, but we say that when the exposed monuments are compared with those which are wholly enveloped, and with those numberless instances in which the traces, in many examples very extensive traces, of the mounds still exist, the fair and legitimate inference is that these so-called "free-standing" structures † were once monuments of the same class as the others, and that they are only in a more advanced stage of decay at the present time.

We go a step further, and say that there are so *very few* instances in which no trace whatever of a mound remains that the argument from inference is greatly strengthened. Have the advocates of the theory ever attempted to sum up *carefully* all the examples of *total* denudation? It has been remarked by the author of "Rude Stone Monuments in all Countries," p. 44, that "probably at least one hundred dolmens in these islands could be enumerated which have not now a trace of any such envelope." There is a confidence in this statement which invites scrutiny, and we venture to say at the outset that it is far from being accurate, for we know that traces of mounds which in some instances no longer exist are upon record, and there is no reason for doubting the record. Immediately following the above statement, a well-known monument is brought forward as one of the unmistakeable hundred examples, and the remark is made that Kits Cotty House, near Aylesford, in Kent, "is exactly now where it was when Stukeley drew it in 1815, and there was no tradition then of any mound ever having covered it," and "we cannot now find a trace of it." But if we pass on to p. 116, where the monument is again mentioned, we find it said, "If we can trust Stukeley's drawing, it was an external dolmen standing on the end of a low long barrow," "the mound has since been levelled by the plough," and "I am inclined to place faith in the drawing." There is no tradition, it is true, of any mound having *covered* it, but how any faith can be put in the drawing, and yet it can be said that the mound has been levelled, which, it is implied at p. 44, never existed, is beyond comprehension. According to Stukeley, therefore, there was not only a trace of the mound, but its form was in his time determinable, and the stone chamber was situated near one of its extremities. This agrees admirably with the construction of many other chambered long barrows where we see the chamber either wholly or in great part enveloped. This monument, therefore, should not be included among the obvious hundred examples.

---

* "Rude Stone Monuments in all Countries, their Ages and Uses."

† These are defined to be dolmens which were never intended to be hidden in any earthen covering, and about which no trace of a mound exists.

Pentre Ifan, in Pembrokeshire, is also brought forward by the same author as another remarkable example in support of the "free-standing" theory. He describes it very briefly and inadequately in pp. 168, 169, and compares it with those which "were, or were intended to be, covered with mounds." There is, he thinks, a very wide difference between it and them, for the latter, he admits, are enclosed sepulchral chambers, whereas as regards the former it never could have been erected to be hid, and "besides that, the supports do not and could not form a chamber. The earth would have fallen in on all sides," &c. Unquestionably there would be much to favour the theory, if it could be granted that the monument is in the same condition now as it always was; but it is known for certain that this is not so. There is, fortunately, a description of it written by Owen more than 200 years ago, and there is also another account by Fenton as it appeared in his day, about seventy or eighty years since, and from these we learn that the aspect of the monument was totally unlike what it is now. There were then eight or nine upright stones under the great roofing stone, now there are only three; then there were the remains round about it of a stone circle 50 ft. in diameter, not now existing; and according to the late Rev. H. Longueville Jones, there were traces, when he saw it, of the original mound. Of the eight or nine upright stones, two, or at most three, supported the capstone, which will easily account for the removal of those which gave it no support. So that in this instance, also, here is a monument which should be excluded from the hundred examples.

On a careful inspection of Plas Newydd, another of the hundred, it will be found that there is evidence both of the encircling ring of stones and of a mound.

It would not be necessary to enter into these particulars but for the oft-repeated assertion of Mr. Fergusson, "no trace of the mound can now be found either around the stones or in the neighbourhood," which is expressed in various ways, and by which he conveys the impression that no mound ever existed; and for the argument which this belief is made to sustain, an argument which we think strongly militates against the idea that all these monuments were destined for sepulchral purposes.

Before passing on to monuments of other lands it will be well to point out the error of one who, with every desire to advance archæological science, has been misled by the classification adopted by Mr. Fergusson. It will not be out of place to do so here, because the views of the writer of the present article have been assailed [*] by this young Cornish antiquary, who has been carried away by his zeal. In order to give support to the "free-standing" theory he enters into a description of Lanyon Quoit, a dolmen standing in the parish of Madron, Cornwall, which he thinks fully establishes it, an opinion shared by Mr. Fergusson (p. 163). But Capt. Oliver, R.A.,[†] has convincingly shown that the monument is not now in the condition in which it used to be; that it has been rebuilt and the position of its supporters have been altered; that these original supporters were stout stone slabs (4 ft. wide by 1 ft. 6 in. thick), and not slim pillars; that whereas there are now three, there were four upright slabs in old Mr. Borlase's time; that two more slabs are lying prostrate close to the others, which it is fair to presume were once upright walling stones of the chamber; and that the monument stands as much *in* as *on* a long mound, which bears every appearance, he adds, of having been a long barrow. It ought therefore to be struck off the list also.

Arthur's Quoit, in Gower, according to Mr. Fergusson, was probably always "free-standing;" but both Sir Gardner Wilkinson ("Archæologia Cambrensis," 1870) and the Rev. E. L. Barnwell have expressed the contrary opinion. The former believes it to have been covered with a tumulus, and the latter writes, "there are cart-loads of stones still remaining, and so little disturbed in position that their outline gives that of the base of the once existing mound." This monument therefore may rightly be excluded from the list.

The elder Borlase describes very accurately all the most remarkable exposed monuments existing in Cornwall in his day, and speaks of the traces of their mounds in every case, *e.g.* Mulfra Quoit, in the remains of a stone barrow; Bosporthenis Cromlech, once in a mound of stones and earth; and Zennor Cromlech, once in a stone barrow.

According to Norden, who described Trevethy Cromlech in 1610, it was "standing on a little hill within a feilde."[‡] Lower Lanyon chamber was discovered in 1790 in a bank of earth and stones; and only one upright stone and the fallen capstone now remain. Pawton Cromlech is still partly "buried in the tumulus which no doubt formerly covered the whole" ("Nænia Cornubia," p. 32). Chywoone or Chûn Cromlech was in a barrow or cairn, 32 ft. in diameter (ibid., pp. 56, 58), and the author of this book says that it so closely resembles a dolmen at Moytura, Ireland, and another at Halskov, in Scandinavia, that the drawings of one might pass for those of the other two. This is a repetition of Mr. Fergusson's remark [§]—the monument "at Halskov is so like the dolmen and circle represented in woodcut 61 that the one might almost pass for the other."

The "free-standing" theory receives no support whatever from the monuments of the Channel and Scilly Islands, nor yet from those of the Isle of Man, so that the area of the British Isles is circumscribed within which the more than hundred examples are to be found. England, Wales, Scotland,[¶] and Ireland contain a large number of rude stone monuments, and the area is sufficiently wide to produce as many as Mr. Fergusson supposes. But it would be a most difficult—we should say a hopeless—task for anyone to attempt to enumerate them and to hand in the required tale.

The writer of the present article has examined the group of monuments known as those of Beni-Messous, or El-Kalaa, in Algeria, and planned several of them. They are all of similar construction, and are simple cists, averaging about 7 ft. by 2 ft. 6 in. (internal dimensions) without galleries. These cists point east and west, with slight variations, and are built with unhewn stones of the locality—tufa and pudding-stone. The mounds, which in a few instances remain intact, are small and of stone, and the chambers which are visible are in various stages of dilapidation and exposure, traces of the mounds being clearly indicated by the quantity of loose stones which are round about them. The place has served for many years as a convenient quarry for the Trappist monks of Staouli, and for the French colonists who have located themselves at Guyotville and Cheragas. If it had not been for a Government order the whole of these monuments would have been carted away for the sake of their building materials. When first discovered they are said to have numbered about 100; about 30 are now left. They are scattered over an area of a few acres, and are arranged without any regularity; and at the period of their completion must have presented a remarkable collocation of stone heaps. The late M. Berbrugger, who was Inspector-General of Historical Monuments in Algeria, was the first to make their existence known, about thirty-seven years ago. Dr. E. Bertherand, the present secretary of the Algerian Acclimatisation Society, has described them in a pamphlet printed by that Society. In 1859 Mr. A. H. Rhind communicated an article upon them to the Society of Antiquaries, London, which is printed in "Archaeologia," vol. xxxviii. M. Réné Galles, the well-known explorer of Brittany dolmens, has also written about them; and the late Mr. J. W. Flower, who visited the spot in 1868, has compiled an article from the foregoing pamphlets, which he read at the International Congress of Prehistoric Archæology held at Norwich in the same year. All these writers have classified them as covered and uncovered tombs, implying, if not asserting in so many words, that the latter had never been covered; *i.e.* "free-standing." Mr. Fergusson has followed their lead, and adopted their classification; but a careful inspection of each exposed monument will convincingly prove that the stone heaps which surround them strongly testify against the theory.

---

[*] NATURE, vol. viii. p. 202.

[†] Ibid. p. 344.

[‡] For account and drawings see "Nænia Cornubia," pp. 46, 47.

[§] Op. cit., pp. 304, 305.

[¶] At p. 240, Mr. Fergusson says—"The free-standing dolmens are few and far between, some half-dozen for the whole country," which again diminishes the area.

When, however, our attention is directed by Mr. Fergusson to continental examples our astonishment at the glaring inaccuracies and contradictory statements is increased, and we wonder that several well-known monuments should have been brought forward to support a theory which their prominent features most clearly refute. There are two in the south of Brittany which have been described by him as belonging to the uncovered class, viz. Dol-ar-Marchand at Locmariaker, and Courconno, in the parish of Plouharnel. Of the latter, he says, "it certainly never was covered up" (p. 343). This is a plain and positive assertion; yet a few pages further on (p. 363) he writes doubtfully, if not contradictingly, on this point: it is "a magnificent cist, walled with rude stone, and such as would form a chamber in a tumulus if buried in one, though whether this particular example was ever intended to be so treated or not is by no means clear." Of the former he writes, it is "the most interesting, if not the finest, free-standing dolmen in France," and "the great stone, like that of most free-standing dolmens, rests on three points, their architects having early learned how difficult it was to make sure of their resting on more. So that, unless they wanted a wall to keep out the stuff of which the tumulus was to be composed, they generally poised them on three points, like that at Castle Wellan."

The question bears quite another aspect, however, when these monuments are carefully inspected, and the treatment they have received at the hands of the inhabitants of late years is inquired into. We thus ascertain that the great dolmen of Courconno is in a very different state now from what it was in 1847, when drawn and described by Cayot-Delandre, the historian of the Morbihan, and that it has been further curtailed of its proportions since 1854. It was then not a mere cist of gigantic size but a huge chamber to which a long covered way or passage was attached, the dimensions of which are given; and there were also traces of the enveloping mound, some of which still exist.

So, too, with regard to the great dolmen of Dol-ar-Marchand, it is not at all as described by Mr. Fergusson. Its chamber has also a long covered way attached to it, which fact he does not mention; both the chambers and the covered way are buried to a depth of several feet in the remains of a circular mound which can be measured: and regular walls line the chamber and the covered way for the express purpose of keeping out the earth composing the tumulus. All these features are incontestably visible. These monuments, therefore, do not sustain the theory.

There are other well-known examples of exposed monuments in France, respecting which a great deal might be written to invalidate the "free-standing" theory. The above will be sufficient to show upon what a weak and indefensible basis it rests.

The theory is supposed, however, to receive the strongest support from a singular monument near Confolens, near St. Germain-sur-Vienne, which is also thought to have been erected as late as the tenth or eleventh century of the Christian era. It is considered of such great importance that it has been engraved and stamped in gold upon the cover of the book which has been so often referred to. It will not be right, therefore, to pass it by. The monument is really a remarkable one, and merits a most careful study on the spot. Owing to its situation in a most out-of-the-way part of France, which entails a very fatiguing journey to reach, few archæologists have had the temerity to undertake the journey, and very few Englishmen have seen it. At a first view it is a very staggering example, but on investigation its simple history unfolds itself in a convincing manner, and quite upsets Mr. Fergusson's conclusions. In brief, it is an ancient sepulchre which has been altered and converted to another use many centuries later. The covering stone is the only remaining relic of the primitive building, and there are incised designs upon its under surface, which point to its early age and use. These designs have only been recently noticed, and the tale they disclose is unmistakeable. This monument was most certainly not a "free-standing" one in the sense implied by Mr. Fergusson, nor was it originally erected at the period he supposes.

The "free-standing" theory, having been adopted, required further confirmation than the external appearance of the monuments was supposed to give it, and its advocates have considered that it is strengthened by the "impossibility of accounting for the disappearance of the mounds," and Mr. Fergusson has followed in the wake of Baron Bonstetten,* whose accuracy of observation does not seem to have been of a high order, and has adopted his language. The Baron says that both Brittany and the Department of the Lot are "pays à dolmens apparents par excellence," by which he means, as he afterwards shows, dolmens which are now as they have always been. This observation proves that he must have given them a very cursory examination. His objection to the tumular belief is thus stated:—"Les dolmens se rencontrent les plus souvent dans des landes incultes et impropres aux défrichements par la nature même du sol. D'ailleurs, dans un but de nivellement on ne se bornerait pas à enlever le tumulus, mais on détruirait encore le dolmen. Les pierres seraient utilisées ou on les enfouirait assez profondément en terre pour qu'elles ne heurtent pas le soc de la charrue," pp. 7, 8. This objection he applies to both the Brittany and the Lot monuments; but what are the real facts? Very many, indeed the larger number, of the dilapidated or partially covered monuments of Brittany are not far from habitations, and although they may stand on uncultivated plots of ground, are surrounded by cultivated lands which are inclosed by loose stone walls. Again, numbers of chambered mounds have been wholly swept away and the materials utilised within the memory of man. Others have been partially removed, and the stone chambers reduced to ruinous heaps; and in some cases, as is well known, deep holes have been dug, and the obstructing blocks buried. And this work of destruction, which is still going on in spite of the prohibitions of the French Government and the legal penalties threatened, has been in operation for centuries. Ought not the knowledge of these facts to have been acquired by the authors, and have made them hesitate before attempting to classify monuments according to their present aspects, without carefully taking into account every possible circumstance connected with the past history of the localities in which they are situated?

---

* "Essai sur les dolmens," Geneva, 1865.

Another Continental writer* has fallen into the like errors through the objectionable practice of following in the track of other authors, and seeing with others' eyes. M. da Costa, following the lead of Baron de Bonstetten, has adopted the classification of these monuments into (1) "dolmins apparentes," (2) "dolmins occultos," and (3) "dolmins construidos sobre um monticulo artificial," against which last class we shall raise a vehement protest by and by.

It results from what has been said, that what is really needed when treating of rude stone monuments is perfect accuracy of description and no omission of any detail or feature which may reasonably be supposed to be connected with the structures. Important omissions of this nature frequently occur, not intentionally, but because of the defective archæological education of the writers, and their want of experience. It is very damaging to the cause of scientific truth when such a theory as the one here exposed is asserted to be supported by examples which really tell against it. Our antiquarian ancestors, who knew very little respecting these monuments, and had few opportunities of comparing them with others in distant localities, who did not know what their true construction and destination were, and mistook the weathering effects on the capstones for channels artificially made, called these structures Druids' Altars, and invented horrible stories of human sacrifices. Assuredly, if it be once admitted that there were "free-standing" monuments which were never inclosed in mounds, then their views may not have been so very far wrong, and some of these buildings may, after all, have been erected for altars of sacrifice. There would be very little proof that they were intended for burial-places. The difference between them (especially those which one author describes as resembling "three-legged milking stools," and another calls "tripod dolmens") and the carefully covered ones, out of whose vaults the earth of the mounds is thoroughly excluded by means of walls of dry masonry, is so great and so striking that the exposed ones could scarcely be with any certainty declared to have been tombs. There is abundant evidence betokening what the covered ones were destined for, and hardly more than a mere assumption as regards the others.

W. C. LUKIS

(*To be continued.*)

NOTES

As usual at this season, scientific congresses are coming thick upon us. The British Association commences its sittings next Wednesday at Belfast, when Prof. Tyndall will give his presidential address. The French Association, as we have said in another column, holds its session at Lille contemporaneously with our own. The British Medical Association commenced its yearly meeting at Norwich on Tuesday, when Dr. Copeman, the president, gave his address; and the British Pharmaceutical Conference brought its eleventh annual meeting to a close in London on Saturday last. The tone of the presidential address by Mr. T. B. Groves, F.C.S., at the last-mentioned meeting, as well as that of Mr. F. J. Bramwell, F.R.S., on the 4th inst. at Cardiff, to the Institution of Mechanical Engineers, was, we are glad to see, decidedly in favour of a more thorough education of those who desire to enter upon these callings in the scientific principles which underlie Pharmacy and Mechanical Engineering. The British Archæological Association at Bristol have been working hard and well in their own interesting department. It has become the fashion in certain quarters to speak slightingly of these annual meetings as being meetings for mere talk and enjoyment; they may be so, but it seems to us that, on the whole, the proceedings prove that much really good hard work is being done year after year in all scientific departments; and it is surely something gained that scientific congresses should have come to be regarded as "popular," and should have all the important cities in the kingdom eager for the honour of their presence.

THE following are the titles of the Evening Discourses to be given at the Belfast meeting of the British Association:—Friday, Aug. 21, by Sir John Lubbock, Bart., F.R.S., "On common Wild Flowers considered in relation to Insects;" Monday, Aug. 24, by Prof. Huxley, Sec. R.S., "On the hypothesis that Animals are Automata; and its history."

THE following foreigners and members of the British Association, among others, have signified their intention of being present at the meeting in Belfast:—Dr. Schweinfurth, Prof. Knoblauch, Prof. Gluge, M. Khanikof, Prof. Delffs, M. Bréguet, Prof. Stoletoff, M. Mannoir, Dr. Williamson, Dr. Hooker, Prof. Stokes, Prof. Adams, Dr. Tyndall, Lord Rosse, Prof. Tait, Prof. Clerk Maxwell, Prof. F. Fuller, Lord Enniskillen, Lord O'Hagan, Prof. Jellett, Mr. Huggins, Dr. Balfour, Dr. Carpenter, Prof. Huxley, Dr. Crum Brown, Prof. Herschel, Prof. W. G. Adams, Mr. Stoney, Dr. Roscoe, Dr. Maxwell Simpson, Prof. G. Foster, Mr. Young, Prof. Hull, Prof. Geikie, Prof. Harkness, Major Wilson, Dr. Odling, Sir John Lubbock, Mr. Bramwell, Prof. James Thomson, Mr. Crookes, Dr. Gwyn Jeffreys, Admiral Ommaney, General Strachey, General Smythe, Col. Strange, Capt. Galton, Mr. Spottiswoode, Prof. Michael Foster, Mr. Ray Lankester, Prof. Clifford, Mr. T. W. Glaisher, Mr. F. Galton, Dr. Pye Smith, Mr. Rodwell, Mr. Chandler Roberts, Prof. Rowney, Prof. Corfield, Dr. W. Farr, Col. Grant, General Alexander, Col. Home, General Jenkins, Capt. Jenkins, Lieut. Conder, Major St. John, Dr. Debus, Mr. Paxton, Mr. Seeley, Prof. Thorpe, Prof. Thiselton Dyer, Mr. Miall, Mr. Symes, Mr. Corbett, Mr. Shoolbred, Mr. Thomas, &c.

DR. COPEMAN, in his presidential address at the Norwich meeting of the British Medical Association, spoke of the impossibility of regular practitioners being able to engage in pure scientific research. "All persons engaged in physiological research," he said, "ought to be provided with sufficient means to enable them to devote their whole time and attention to their work, without the cares and troubles of practice; while, on the other hand, those who were engaged in the great and paramount object of curing disease could not possibly spare the necessary time for minute physiological investigations. Each, however, could materially assist the other; the practitioner could furnish facts and observations which might greatly assist the physiologist in his experiments, and the latter could enlighten the former by giving reasons for the facts presented to his notice. The majority of medical men must be practitioners and earn their living by practice; but he hoped that in a society like the British Medical Association means would before long be found to supply the necessary funds to a certain number of gentlemen with young and healthy minds congenial to the work to enable them to devote their time and energies to physiology as a separate study."

---

* "Descripcao de alguns Dolmins ou Antas de Portugal," por F. A Pereira da Costa. (Lisboa, 1868.)

IN many French daily newspapers predictions of the future weather have been recently given, which were attributed to the Paris Observatory. Although the Observatory, however, published nothing on the subject, the statement was so widely believed that M. Leverrier felt it necessary to protest against it in his *Daily Meteorological Bulletin*. French meteorology, as we recently intimated, is undergoing a reorganisation in consequence of the vote of the Council of the Observatory. No final decision has been arrived at, although we learn on M. Leverrier's authority that a decision may be speedily expected. We hope to be able to give details when the arrangements have been finally made.

THERE is some hope that an Arctic expedition of discovery may be despatched in the spring of 1875. The Prime Minister has undertaken to consider the subject carefully in all its bearings, and on the 1st of this month the presidents of the Royal Society and of the Royal Geographical Society, accompanied by a gallant admiral of long Arctic experience, had a preliminary interview with Mr. Disraeli.

THE French Alpine Club has sent a party of ten young men under the guidance of M. Albert Tissandier to travel on the Alps and draw up a report of their excursion; others will be sent next year, this being the inauguration trip of the society.

FROM a recent report on the trade of Bremen we learn that a branch of industry, which is gradually increasing in importance, has arisen of late in the barren moorlands of North-western Germany by the preparation of peat or turf. This material is largely used in Germany as fuel both in private dwelling-houses as well as in some large establishments, and, it is stated, also on the Oldenburg Railway. Two companies have lately been formed in Oldenburg for the purpose of manufacturing peat on a large scale, and of supplying it to the inhabitants of Bremen, Oldenburg, and other towns in the neighbourhood, at a far cheaper rate than that now paid to the peasants, who have hitherto almost had a monopoly of the trade in this article. The peat is cut out of the soil of the marshy moors or bogs which extend from Bremen to the Dutch frontier, by machinery; by the removal of the peat a network of canals is formed, which are of use for conveying the peat itself to market, and which likewise form new permanent channels of communication available for all other purposes. The peat-cutting machine consists of a large flat-bottomed steam-vessel, which, when set to work, is able to cut a canal 20 (German) ft. in breadth and 6 ft. in depth, whilst proceeding at the rate of from 10 to 12 ft. per hour. The soil thus cut out by this floating peat manufactory is lifted into the vessel by steam power, and after being thoroughly ground is deposited, by means of a long pipe running out of the side of the vessel, alongside the bank of the canal, where it is subsequently cut into the shape of bricks and dried. It is stated that by this method about 1,000 centners (55 tons English) of a very good kind of peat may be manufactured per day. In view of the present high price of coal, particularly in Britain, and of the great importance which attaches to the question of obtaining a cheap kind of fuel at all times, it might perhaps be well worth while to consider whether this system of peat manufacture could not be introduced in many other parts of Europe, where the soil is doubtless as well suited for the purpose as in Oldenburg.

IN the *American Journal of Science and Arts* for August, Prof. A. W. Wright, of Yale College, describes his polariscopic observations of Coggia's comet. On the evening of July 6 the polariscope showed the bands, both bright and dark, quite definitely, and they were seen with comparative ease. Observations repeated a number of times agreed in showing that the light was polarised in a plane passing through the axis of the tail, that is, as nearly as could be estimated, in a plane passing through it and the sun. Other observations made on the evening of July 14, when the sky was quite clear, gave the same result, though less satisfactorily, as the twilight had begun to interfere with the observations. After waiting until this had disappeared, it was possible to see the bands, though with some difficulty, and the degree of the polarisation appeared to be decidedly less than on the previous occasion. The circumstances were too unfavourable to admit of any determination of the percentage of light polarised, but it was certainly not large. The fact of polarisation shows that a considerable portion of the light of the coma is derived from the sun by reflection.

A COMPANY has been formed to work the sulphur deposits at White Island, a marine volcano 140 miles from Auckland. It is estimated that 100,000 tons of sulphur in an almost pure state are lying on the island ready for shipment. Chemical works are likely to be established soon, and the island leased.

A NEW university will be opened at Agram, in Croatia, in October next. It will have the name of the "Francis-Joseph University."

H.M.S. *Shearwater* left Capetown on July 14 for Mauritius, with the members of the expedition who are to observe the Transit of Venus from that island.

DETAILS appear in the *Times* and *Daily News* of the expedition of H.M.S. *Basilisk*, which, as we have already (vol. x. p. 215) intimated, has been exploring the north-eastern shores of New Guinea. The ship had arrived at Singapore at the end of June, the expedition and the survey of Goschen Strait and the coast from East Cape to Cape Rigny, of the Astrolabe Gulf—about 500 miles—having occupied four months. Lieut. Dawson was to return on July 15 by Torres Straits to Sydney, whence he proceeds to Fiji to survey and report upon the harbours and passages. Riche—the island of D'Entrecasteaux, who visited these coasts in search of La Perouse in 1793—was found not to exist now. To the large D'Entrecasteaux group the names of Normanby, Fergusson, and Goodenough were given by Capt. Moresby. The coast was varied in feature, being at times bold and steep, with lofty mountains, at others low and wooded, with off-lying coral banks and dangers. The natives became less friendly as the expedition went westward. Venomous snakes were found, but no wild animals. About 300 miles westward of East Cape the natives were stark-naked and more debased. Collections of implements, articles of dress, and ornaments were obtained in great quantities; among the former, tortoise-shell axes and models of the war canoes. A few botanical and natural history specimens were obtained by the medical officers, as well as a rough vocabulary of the language. At Amboyna (Dutch settlement) the *Basilisk's* officers met Mr. Alexander Miclucho Macleay, the Russian traveller, who had recently returned from the north-west coast, where the natives had been hostile and had eventually ousted him. Full of zeal in his work, he had overdone it, and was suffering at Amboyna from scurvy, and afterwards erysipelas. The Dutch medical authorities thought his condition serious when the *Basilisk* left Amboyna. The surveys of the *Basilisk* have opened up a new route to Sydney, which is 280 miles shorter than the shortest previously known route.

MR. HENRY SKEY, of the Observatory, Dunedin, Otago, New Zealand, writes in reference to the mention which is made in NATURE, vol. vii. p. 25, of Prof. Capocci's idea of constructing a revolving mercurial speculum for a reflecting telescope, that he would like to know if such an instrument has actually been constructed. The same idea, Mr. Skey states, presented itself to himself, and he also constructed a telescope on this principle many years ago in England without knowing that the method was engaging the attention of others. He sends an account of a mercurial reflecting telescope exhibited by him before the New Zealand Institute, Nov. 19, 1872, which is published in the Transactions of that Institute, vol. v. p. 149.

THE *Times* of Monday and Tuesday contains some interesting details concerning Col. Gordon's African Expedition from one of his staff. The latest date is June 18, when the various detachments were in boats on the White Nile, making the best of their way to Gondokoro. One of the objects of this expedition, as our readers no doubt know, is to carry out the work so well begun by Sir Samuel Baker in the suppression of slavery. Col. Gordon expects to have steamers on Lake Albert Nyassa by November next; and the Rev. H. Waller, writing in the *Times*, states that by taking the Suez, Souakim, Berber, and Khartoum route, it is quite possible to reach Gondokoro in forty-eight days from England, including a week's rest at Khartoum.

IN the "Tijdschrift voor entomologie uitgegeven door de Nederlandsche entomologische vereeniging" is a useful paper On *Acentropus* (Curt.), by Mr. Ritsema. He refers to the passage in the preface to the *Zoologist* for 1857: "We have an aquatic section of Diptera, Neuroptera, Coleoptera and Hemiptera; it is in perfect accordance with the known laws of Nature that there should be an aquatic section of Lepidoptera;" and he quotes the opinion given by Dr. Hagen in July 1856, that *Acentropus niveus* is a lepidopterous insect of the family Crambidæ. He then gives in chronological order extracts from writers in different countries who regard *Acentropus* as lepidopterous, and adds in conclusion a list of the streams and ponds where it has been found. Stephens, in 1835, raised the question whether his *Acentropidæ* ought not to be placed under Lepidoptera, but Dr. Ritsema does not quote him.—There is also a continuation of a new catalogue of the Hymenoptera of the Netherlands, by Snellen van Vollenhoven, with localities and list of synonyms. 1,072 species are enumerated, of which 13 are described in full as new to Science.—Dr. Ritsema describes the male of a Xylocopa, of which he says he knows only some eight or nine examples, and of which there is no specimen mentioned in the British Museum Catalogue. He gives two coloured figures.

AN Entomological Club has been formed at Cambridge, Massachusetts, having for its object the mutual interchange of discoveries and observations in regard to entomology. It has been determined to undertake the publication of a monthly organ to be called *Psyche*. This will contain such a part of the proceedings of the Society as are considered of general interest, communications, lists of captures, and especially a *Bibliographical Record*, in which will be given a list of all writings upon entomology published in North America, and all foreign writings upon North American entomology from the beginning of the year 1874. The editor is Mr. B. Pickman Mann, of Cambridge, Massachusetts. The first number contains an article by Mr. Scudder, on the English names for butterflies, and the first part of the *Bibliographical Record*.

WE have received from the Royal Observatory, Cape of Good Hope, "The Cape Catalogue of 1,159 Stars, deduced from Observations at the Royal Observatory, Cape of Good Hope, 1856 to 1861, reduced to the epoch 1860," under the superintendence of E. J. Stone, F.R.S., H.M. Astronomer at the Cape.

WE learn from the *Gardener's Chronicle* that there is to be an exhibition of useful and noxious insects during next month at the Tuileries, Paris. The exhibition commences on the 6th and is under the auspices of the Société Générale d'Insectologie. In a country where the vines are being devastated by *Phylloxera* and where an epidemic disease has been spreading among the silk-worms, the value of such exhibitions cannot be over-estimated.

A PAPER by Mr. N. Whitley, C.E., entitled "The Palæolithic Age Examined," read before the Victoria Institute, has been published (Hardwicke) in a separate form, along with the subsequent interesting discussion, in which Dr. W. B. Carpenter, F.R.S., Mr. John Evans, F.R.S., Mr. W. C. Borlase, Mr. Charlesworth, and others took part.

MESSRS. BLACKWOOD and Sons have in the press and nearly ready for publication, "Economic Geology; or, Geology in its relations to the Arts and Manufactures," by David Page, LL.D.

MESSRS. LONGMAN will shortly publish the following works bearing upon Science:—"The Primeval World of Switzerland," by Dr. Oswald Heer, translated from the German and edited by James Heywood, F.R.S.; this work will be illustrated. "The Sun: an account of the principal modern discoveries respecting the Structure of the Sun of our System," by Father Secchi, translated and edited by Richard A. Procter. "The Star Depths; or, other Suns than ours," by Richard A. Procter. "An Introduction to Experimental Physics," by Adolf F. Wermhold. And a new edition of Dr. Neil Arnott's "Elements of Physics," edited by Alexander Bain and Alfred Swain Taylor.

M. GÖPPERT has issued a little "Guide to the Royal Botanic Garden of the University of Breslau," containing an interesting account of its various collections, and of the most important plants grown in it, illustrated by a map.

WE have received Mr. Ellery's *Monthly Record* of observations taken at Melbourne Observatory in December and January last. The mean temperature in the former month was 67·2°, being 3·6° higher than the last fifteen years' average, and the highest on record with one exception. The highest temperature in the shade was 101·2°, the range in the month being 56·3°.

THE most recently published parts of the new edition of "Griffith and Henfrey's Micrographic Dictionary" bring the work down as far as "Mouth." The publication continues to maintain its high scientific character.

THE additions to the Zoological Society's Gardens during the past week include two Egyptian Gazelles (*Gazella dorcas*) from Egypt, presented by Mr. G. Muscat; four Rufous Tinamons (*Rhynchotus rufescens*) from the Argentine Republic, presented by Mr. Alfred O. Lumb; three Mastigures (*Uromastix sp.* ?) from Persia, presented by Captain Phillips; one Yaguarundi Cat (*Felis yaguarundi*) from South America, deposited.

U. S. WEATHER MAPS

THE *American Journal of Science and Arts* for July contains an article on Results derived from an Examination of the United States Weather Maps for 1872 and 1873, by Elias Loomis, Professor of Natural Philosophy in Yale College.

Prof. Loomis had a number of outline maps of the United States prepared, and on these he traced the tracks of all the storms, whenever a storm-centre could be satisfactorily located, for two successive days, the maps exhibiting, on the aggregate, storm-paths for 314 days. These results were then reduced to a tabular form by measuring with a protractor the bearing of each storm-path with reference to a meridian, and measuring the daily progress of the storm on a scale of inches. This *table* showed the date of each storm, the velocity of its progress, the direction of its path, together with readings of the barometer before, during, and after a storm, and from it were calculated the following:—The average direction of the storm-paths for two years was 8° to the north of east, and the average velocity wa 25·6 miles per hour. July is the month in which the course is most south, and October in which it is most north. February is the month of greatest, and August of least velocity, the former exceeding the latter by 75 per cent. In some instances a storm-centre has remained stationary for twenty-four hours, and in four cases it travelled 1,200 miles in that time. In one case a speed of 57·5 miles per hour was reached. In April 1873 a storm-centre changed its path 360° in 24 hours. Taking into account the actual motion of a storm-centre from hour to hour, it seems that a storm-path may have every possible direction, and the velocity of progress may vary from 15 miles per hour westward to 60 miles per hour eastward.

The fall of rain seems to have a decided influence in modifying the course of a storm-path. The rainfall area is usually much larger to the east of a storm-centre than the west, 500 miles being the average length on the east side. There is a connection between the velocity of the storm's progress and the extent of this rain area—for example, when the eastern extent is 100 miles greater than the mean (500 miles), then the hourly velocity increased 14·9 miles beyond the mean (25·6), but when the eastern extent of the rain area is 100 miles less than the mean, the hourly velocity of the storm's progress is diminished 8·1 miles.

As to the direction in which the rain area is most extended, the axes of the areas were compared with the storm-paths, and gave this result, that the average course of a storm-path for twenty-four hours coincides very closely with the position of the axis of the rain area for the preceding eight hours.

Prof. Loomis says: "The progress of a storm eastward is not wholly due to a *drifting*, resulting from the influence of an upper current of the atmosphere from the west, but the storm works its own way eastward in consequence of the greater precipitation on the eastern side of the storm. Thus the barometer is continually falling on the east side of the storm and rising on the west side, in consequence of the flowing in of colder air on that side."

In order to trace the influence of the wind's velocity upon the progress of storms, Prof. Loomis divides a circle into four quadrants, and by an arrow in each, showing the average direction of the wind, it is at once perceived that there is a strong tendency of the winds inward to the centre of the storm; but the average direction in each quadrant differed from what it would be if the wind revolved in a circle round the storm-centre.

The velocity is greatest in the west quadrant and diminishes in the successive quadrants as we pass round the circle from west by south to north. On each side of the storm's centre the wind blows obliquely inward, and hence it is inferred that in the central region of the storm there is an upward motion of the air, and this is the cause of the precipitation of vapour; that is, the cause of the rainfall.

The average rise of a barometer for twenty-four hours in the rear of a storm is sensibly greatest when the velocity of progress is greatest. Prof. Loomis believes it is possible to predict where a storm-centre will be at the end of twenty-four hours.

His inquiries into the relation between the velocity of the wind and the velocity of a storm's progress have led to the conclusion that at a height of 6,000 ft. in the western quadrant of a storm the velocity of the wind is 68 per cent. greater than the velocity with which the storm advances.

He then considers how to determine whether a storm is increasing or diminishing in intensity, and concludes that when the barometer rises more rapidly than usual as the storm passes by, the pressure at the centre of the storm is increasing; but when in the rear of the storm the barometer rises less rapidly than usual, the pressure on the centre is diminishing or the storm is increasing in intensity. Sections on "The Form of Isobaric Curves," on "The Classification of Storms," and "Where do the Storms which seem to come from the far west originate?" conclude the article.

SCIENTIFIC SERIALS

The Geological Magazine, August.—This number contains five original articles. 1. Notes on fossil Orthoptera related to Gryllacris, by A. H. Swinton. The fossil remains are two from the eocene and three from the coal formation. The two eocene are, *Gryllacris Ungeri* of Heer, and *G. Charpentieri* of Heer. The coal species are, *Gryllacris lithanthraca*, two species, and *Gryllacris [Corydalis] Brongniarti* (Aud.). In the specimen *G. Brongniarti* there are indications of the "file," on which Mr. Swinton remarks; "We see this ancient instrument of music had already attained to all appearance an efficiency at least thrice that of our modern house cricket, and must have emitted notes that rang widely over the tropical forests that clothed our island in the old days of the coal period."—2. On the Source of Volcanic Heat, by Mr. G. Poulett-Scrope. Four-and-a-half pages are occupied in disavowing the views "saddled" upon him by Mr. Mallet, and in saying that Mr. Mallet's "definition" is a statement of a series of conjectures.—3. On the Glacial Epoch, by Mr. Croll. This is a continuation of the article commenced last month. The probable thickness of the Antarctic ice-cap was then considered, and now the results of the melting of a portion of it are calculated. The Antarctic ice-cap is equal in area to 1–23·46 of that covered by the ocean; therefore 25 ft. 6 in. melted off would raise the general level of the ocean one foot, and one mile melted would raise the level 200 ft. Mr. Croll takes for the time of his calculation the period when cold was increasing in the northern hemisphere and warmth in the southern. The lessening of ice-cap in the southern and an accumulation of ice in the northern would displace the centre of gravity of the earth leading to a rise in the sea-level in the northern hemisphere. This, with the rise resulting from the melting, Mr. Croll calculates would give for the latitude of Edinburgh a rise of sea-level of 800 to 1,000 ft. The supposition of the subsidence of land during our glacial period may therefore, he argues, be dispensed with; and he proceeds to show how this theory avoids many difficulties which the elevation and subsidence theory leads to. Further: the oscillations of sea level resulting from the displacement of the earth's centre of gravity throw light on many obscure points connected with the geographical distribution of animals and plants. For example, during the warm periods the English Channel would be dry land, and during the cold animals might cross to England from the north upon a frozen sea. And still further: if we knew (1) the extent of the general submergence of the glacial epoch and (2) the present amount of ice in the southern hemisphere, we could determine whether or not the earth is fluid in the interior.—4. Geological notes from the neighbourhood of Cairo, by John Milne. The article, which is too long for us to notice, is illustrated by a section and sketch maps.—5. The Red Chalk in Yorkshire, by the Rev. J. F. Blake. The paper principally refers to the occurrence of *Ammonites Deshayesi* in the red chalk, in the pebble-beds below it, at Hunstanton, in the Specton clay, and in the gault of Folkestone. The chalk is a deep-sea deposit, and in the sinking of the land in Upper Cretaceous times the passage beds from the Upper Neocomian to the Aptien were laid down in various areas from various sources. *A. Deshayesi* evidently lingered on during the time these changes were taking place till the red chalk set in in Yorkshire and the gault at Folkestone.—Among the reports is a notice of the Cotswold Club visit to Bath and a *résumé* of a paper, read by Dr. Wright, On the genesis of the oolites.

Proceedings of the Liverpool Naturalists' Field Club, 1873-74.—This club, which is fourteen years old, we are glad to see continues in a flourishing condition as regards members and funds, and has, during the session 1873-74, been doing a fair amount of work. The present number of the Proceedings contains the address of the president, the Rev. H. H. Higgins, at the annual meeting, in which he touches on a variety of topics more or less connected with Natural History; following this is a list, prepared by Mr. Higgins, of all works bearing on the Natural History of the district of Liverpool from 1705 to the present time. The club made ten excursions during the summer and autumn of 1873, and an account of these, with the detailed results of some of them, occupies part of the number. Appended is a list of excursion prizes to be competed for this summer, and the names of last years' winners.

Proceedings of the Winchester and Hampshire Scientific and Literary Society, vol. 1, part iii. (1872-3).—We learn from the Fourth Annual Report of the society that as a consequence of altering the rules so as to admit ladies, several ladies have become members. We are glad to see also that sections have been formed for the special study of botany, entomology, and zoology, and that work has already been done in each of these departments. During 1873, eighteen papers have been read in the society, most of them on subjects connected with science. In an introductory lecture, the Rev. E. Firmstone gives an interesting *résumé* of what is known about the "Star Depths." Among the other papers we would note an ingenious one On the probable origin of flints, by Mr. A. Angell, jun.; "The Heraldry of the World," a long paper, amply illustrated, by Miss Zornlin;

On some of the parasitic fungi common in the neighbourhood, by Mr. F. J. Warner, F.L.S.; Notes on new or rare Hampshire insects, by the Rev. W. Spicer; and an interesting paper on Lapland.

THE *Geographical Magazine*, August.—This number opens with an interesting account, illustrated by a map, of the Cameron African Expedition up to the beginning of the present year. In "The Lufiji River and the Copal Trade," some account is given of recent explorations of the delta of this little-known African river. Capt. Davis continues his notes on the voyage of the *Challenger*, Mr. G. Turner his "Impressions of Jamaica," and Mr. H. P. Malet his "Sign-posts on Ocean's Highway," in which he brings together various theories on the formation of mountains. "Djetyshahr (Eastern Turkestan), its Sovereign and its Surroundings," is the title of a paper, with a map, by Mr. R. Michell. In an article on "The Archæological Survey of India," an account is given of some important discoveries recently made among the Buddhist remains of Bharahut, in the Central Provinces. The number also contains a very interesting account of a recent visit to the Caroline Islands.

Bulletin de la Société d'Anthropologie de Paris, t. viii.—The diminution in the population of France which had taken place between the census of 1866 and that of 1872, and is far in excess of what may be referred to losses in battle and the annexation by Germany of the Alsace-Lorraine territory, has been made the subject of a series of papers by M. Bertillon. The whole subject of the decrease of the population in France is one that is necessarily engaging the attention of medical as well as statistical writers. In the discussion which M. Bertillon's paper raised at the ordinary meeting of the Society, M. Lagneau drew attention to the results given in a paper read by himself before the Académie de Médecine On the census of 1872 and the condition of the population of France, in which he has attempted to show that the small number of births when compared with the deaths is to be referred, not to any special ethnogenic or climatic relations, but rather to the influence of certain laws of succession and subdivision of property, and to the agency of military enactments, the one inducing late marriages and the other enforcing celibacy on a large proportion of men in the prime of life.—A valuable Report has been drawn up under the direction of the Commissioners for Algeria, by M. le Général Faidherbe and others, on the anthropology of that province, and has been formally presented to the Anthropological Society of Paris. After a general preliminary dissertation by M. Faidherbe on the different races which have occupied or still occupy the Algerine territory, Dr. Topinard considers at great length the ethnological, social, moral, linguistic and other relations of the Arabs and Berbers, who constitute the main branches of the French tributary tribes.—M. Roujou attempts in a lecture, which he delivered before the Society in the course of last year, to prove that a fair-haired race occupied the Gallic soil before the advent of the Germanic tribes, including Gauls under that denomination. He is of opinion that the ancestors of the Hellenes, the constructors of those megalithic remains which extend from the Atlantic to the Indian Ocean and from Scandinavia to Africa, and the fair-haired invaders of Egypt, who sixteen or seventeen centuries before our era had reached the Nile from the north-west, all belonged to one ancient blonde race, which long before the appearance of Teutons and Gauls had occupied Western Asia, Northern Africa, and the lands of Europe as the dominant or aristocratic class. M. Roujou discusses the much-vexed question whether the primitive Celtic races were fair or dark, dolichocephalic or brachycephalic, the former opinion being maintained by Dr. Pruner Bey, while the latter view is supported by all the learning that the great anthropologist, Dr. Broca, can advance in its favour.

Annali di Chimica applicata alla medicina, vol. lviii. No. 6, June.—This part concludes the eighteenth volume and contains the following papers:—In pharmacy, G. Righini furnishes a contribution on the iodides of sodium and ammonium and the production of iodoform in a mixture of these salts.—Dr. Coutinho furnishes a paper on the use of *Jaborandi*, a tree growing in North Brazil.—There is also a paper in this section on Anglo-Saxon condensed milk, reprinted from *Le Mouvement Médical* for March.—In hygiene, there is a paper by Pietro Carpani On a simple method for determining the quantity of lead contained in pewter vessels.—Action of water on lead, by Fordos.—In dietetics, Dr. F. Turbacco furnishes the concluding part of his paper On cheese and its alimentary use.—In physiology, Dr. G. Cappelli has a communication On the anti-fermentative action of boric acid and its efficacy in certain diseases.—Studies relating to the question of heterogenesis, by Prof. G. Cantoni.—Under the heading "Varieties" there is a paper by Gioachino Curti On the substitution of the earth of the *solfatara* of Pozzuoli for sulphur in the sulphurisation of vines.

Gazzetta Chimica Italiana, fascicolo iv.—This number commences with a paper by Prof. E. Pollacci On the mode of action of sulphur on calcium carbonate. Dr. Giuseppe Bellucci furnishes also a contribution on the same subject.—Chemical analysis of a marine plant (*Posidonia oceanica*, Koen) used in Liguria as manure, by Fausto Sestini.—Hugo Schiff contributes a paper On some derivatives of phloretine. The author describes in detail the method of preparing this substance, also the preparation of phloroglucine, phloretic acid, phloroglucide and triphloretide.—A. Pavesi and E. Rotondi give an account of the work done in the chemical laboratory of the Agricultural College of Milan. This comprises papers On rice oil; On the analysis of volcanic ashes which fell at Naples; the solubility of calcium phosphate in sulphurous acid; On parabuxine, a new alkaloid contained in *Buxus sempervirens* (the sulphate has the formula $C_{36}H_{48}N_2OSO_4H_2$); On a practical method of determining the degree of acidity of milk; and, finally, On the quantitative determination of tannin especially in the must of grapes and in wine, modification of Flek's method.—The following papers are communicated from the station at Asti:—On the chalkiness of must, by Dr. L. Macagno.—Influence of light on vegetation, by the same author.—Experiments on the process of fermentation, by the same author.—The remainder of this part consists of a summary of foreign journals.

SOCIETIES AND ACADEMIES

LONDON

Royal Horticultural Society, August 5.—W. A. Lindsay in the chair.—The Rev. M. J. Berkeley called attention to *Fuchsia procumbens*, an interesting species—probably nearly hardy and suitable for rockwork—from New Zealand; *Pavia macrostachya* and *Clethra arborea* were sent from the gardens of Syon House.—Mr. H. B. Hennel exhibited a large plant of *Lilium auratum* with two stems—one fasciated, bearing forty-eight, and the other seventeen flowers.

PHILADELPHIA

Academy of Natural Sciences, Feb. 3.—Dr. Ruschenberger, president, in the chair.—Dr. Chapman exhibited a dissection of one of the hind legs of a musk-rat, *Fiber zibethicus*. The tendons of the tibialis anticus, extensor proprius hallucis, and extensor longus digitorum, pass down a groove in the tibia and under a little process of bone. The extensor longus digitorum is held down by an additional process. This arrangement seems to quicken the extension of the foot, and is of use apparently to the animal in swimming.—Prof. Leidy remarked that while it was exceptional to find the same species of the higher sub-kingdoms in the different parts of the world, it appeared to be the rule that most species of *Protozoa* were found everywhere under the same conditions. A large number of our fresh-water forms he had recognised as the same as those described by European authors. A less number of species are probably peculiar to every region. Among our fresh-water *Rhizopods* he had observed not only the genera *Amœba*, *Arcella*, *Difflugia*, *Euglypha*, *Trinema*, *Lagynus*, *Actinophrys*, &c., but also most of the species of these as indicated by European naturalists. It is an interesting question whether our fresh-water *Protozoa* have reached us from the same sources as those of Europe and other remote countries. If derived from the same sources they were probably infused in the waters of the different continents at an early age when the latter were not separated by ocean barriers. If thus early infused we have a remarkable instance of a multitude of specific forms retaining their identity through a long period of time. Such a view might appear to oppose the doctrine of evolution, but not justly so, for the simplest forms would be the slowest or least likely to vary, while the most complex, from their extended relationships, would be most liable to variation. Perhaps, however, the simplest forms of life, of the same species, may have originated independently of one another, not only in different places, but also at different times, and may yet continue to do so. While the highest forms of life may have been slowly evolved from the simplest forms of the remotest age, equally simple forms may have started into existence at all times down to the present period. From the later original forms new ones may have been evolved to speed towards the same goal as those which preceded them.

Feb. 17.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy made some remarks on the mode of reproduction and growth of the *Desmids.* In illustration he described a common species of *Docidium* or *Pleurotænium.* This consists of a long cylindroid cell constricted at the middle and slightly expanded each side of the constriction. When the plant is about to duplicate itself the cell-wall divides transversely at the constriction. From the open end of each half-cell there protrudes a colourless mass of protoplasm defined by the primordial utricle. The protrusions of the half-cells adhere together and continue to grow. The bands of endochrome now extend into the protrusions and subsequently keep pace with their growth. The protrusions continue to grow until they acquire the length and form of the half-cells from which they started. The exterior of the new half-cells thus produced hardens or becomes a cell-wall like that of the parent half-cells. In this condition two individuals of *Docidium* are frequently observed before separation. During the growth of the new half-cells the circulation of granules in the colourless protoplasm is quite active. In a species of *Docidium* 1½ mm. long by $\frac{1}{16}$ mm. broad, the growth of the new half-cells was observed to be at the rate of about ¼ mm. in an hour.

March 3.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy read an extract from a letter relating to mammalian fossils in California, from Dr. Lorenzo G. Yates, of Centreville, Alameda County, California.

March 10.—Dr. Ruschenberger, president, in the chair.—Elevation of the trunk of trees.—Mr. Thomas Meehan suggested on a former occasion that trees growing on a rock, by the natural thickening of the roots beneath would lift the tree four inches in forty years. Since that time, however, Dr. Lapham, the botanist, and State geologist of Wisconsin, had suggested to him that frost gradually lifted trees so that the trunk would sometimes appear in time to have elongated a foot or more. Since Dr. Lapham had made the suggestions, he had examined trees in the vicinity of Philadelphia and found unmistakable evidence that large numbers of trees had been raised in the manner stated. It was likely that one of the chief offices of the tap roots was to guard the tree from this frost-lifting as much as possible. His impression was that the trees of tropical climates had not near the development of tap roots which are found in the more northern ones, but this was a matter for further investigation.

March 24.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy read a paper on *Actinophrys sol.*

VIENNA

Imperial Academy of Sciences, March 26.—Prof. Freih. von Ettingshausen presented a memoir On the history of the development of terrestrial vegetation. The first part treats of Tertiary floral elements and the genetic relation of these to present flora; the second, the elements of European flora.—Dr. Schrotter spoke on the transformation of ordinary into amorphous phosphorus, through action of electricity, and described three forms of apparatus prepared by Dr. Geissler, of Bonn, for the purpose. There is evidence that the change is wrought neither by the light nor by the heat accompanying the current, but by the electricity itself.—Dr. Meyer presented a second paper On new and imperfectly known birds of New Guinea and the islands of the Bay of Geelvinks.—Dr. Frombeck communicated a memoir On an extension of the doctrine of sphere functions and the forms of development, from these, of a function in infinite series.

PARIS

Academy of Sciences, Aug. 3.—M. Bertrand in the chair.—The following papers were communicated:—Double series of drawings representing terrestrial cyclones and solar spots, executed by M. Faye. The drawings are to be published in the Mémoires; the present communication contains a detailed description of them.—Eighth note on guano, by M. E. Chevreul. The author has detected the following salts in guano:—Ammonium carbonate and chloride, calcium urate, phosphate, and oxalate; certain potassium salts of volatile organic acids. The following double salts have been recognised:—Potassium ammonium oxalate, potassium ammonium sulphate, sodium ammonium phosphate, and magnesium ammonium phosphate.—Note on a meteorite which fell on May 20, 1874, in Turkey, at Virba, near Vidin, by M. Daubrée. The fall was accompanied by a loud noise, and the mass, weighing 3·6 kilogrs., penetrated 1 metre into the soil. Analysis showed that the meteorite contained nickel-iron, chrome-iron, ferric sulphide, and an insoluble residue, probably containing enstatite.—Additional note on the fall of meteorites which took place on July 23, 1872, in the district of Saint-Amand (Loir-et-Cher), by M. Daubrée. By an attentive examination of the surface of the soil, four other meteorites weighing respectively 3, 0·3, 0·6, and 0·6 kilogrs. have been discovered.—Blast of sirocco experienced in Algiers on June 20, 1874, and followed over a great part of Algeria, by M. Ch. Sainte-Claire Deville.—Observations made during the last days of the appearance of Coggia's comet; a letter from P. A. Secchi to the perpetual secretary. The author obtained undoubted evidence of polarisation. The linear spectrum of the nucleus apparently continuous was resolved by careful examination into a banded spectrum, the interruptions of which were most apparent near the bands of the second spectrum superposed upon the continuous spectrum of the nucleus. A drawing of the spectrum accompanied the letter.—Indication of a method of establishing the properties of the ether, by M. X. Kretz.—Reply to a former note by M. Houyvet on the scheme for re-establishing a central sea in Algeria, by M. E. Roudaire. The author does not fear that the evaporation would dry up the proposed sea into a salt lake as suggested by M. Houyvet; he is of opinion that such a circumstance would be entirely prevented by the establishment of an inferior counter current.—Memoir on the thermal effects of magnetism, by M. A. Cazin. The author has determined approximately the magnetic equivalent of a *calorie.*—Researches on explosive bodies; explosion of powder; by MM. Noble and F. A. Abel: continuation of first memoir.—Fourth note on the electric conductivity of ligneous bodies, by M. T. du Moncel.—On the passivity of iron, by M. P. de Reynon. The author attempts to explain this phenomenon by a voltaic action transferring oxygen to the iron, and thus polarising the surface of this metal.—On some bismuth and tungsten minerals from the Meymac mine (Corrèze), by M. Ad. Carnot.—Observations on the development of the peripheral nerves of the larvæ of Batrachians and Salamanders, primary and secondary fibres, M. Ch. Roget.—Reproduction by photography of different crystallisations such as are seen under the microscope, by M. J. Girard.—Note on the stratification of the tail of Coggia's comet, by M. A. Barthélemy.—On isoterebenthene from a physical point of view, by M. J. Riban. The author has instituted comparisons between the physical properties of this substance, terebene, and terebenthene.—Constitution of ordinary brominated propylene, by M. E. Reboul.—Action of nitric acid on paraffin; different products obtained; by M. A. G. Pouchet. Among other substances, *paraffinic acid* ($C_{16}H_{28}NO_{10}$) is obtained, which the author has examined in some detail.—On the action of chloral on the blood, by MM. V. Feltz and E. Ritter.—Observations on the hailstones which fell at Toulouse during the storm of July 28, 1874, by M. N. Joly.—Reply to M. Leymerie on the subject of the carboniferous limestone of the Pyrenees and the St. Béat marbles, by M. F. Garrigou.—Observations of a bolide at Versailles on the evening of July 27, by M. Martin de Brettes.—Observation of a bolide at Toulon on July 27, by M. Lecourgeon.

CONTENTS

PAGE
ICELAND'S MILLENARY 279
RECENT RESEARCHES IN PHOTOGRAPHY. By R. MELDOLA, F.C.S. . . 281
LADY BARKER'S "LESSONS ON COOKING" 283
MAUNDER'S "TREASURY OF NATURAL HISTORY" 283
OUR BOOK SHELF 284
LETTERS TO THE EDITOR:—
  The Woolwich Aëronautical Experiment.—W. DE FONVIELLE . . 285
  Fogs, Field-ice, and Icebergs in the Atlantic.—Capt. WM. W. KIDDLE . . . 285
  Science at Cambridge.—GEORGE DARWIN 286
  Circulation of Apparatus and Scientific Works 286
  Sounding Flames.—Dr. T. STREETHILL WRIGHT 286
THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE . . 286
THE COMETS. By J. R. HIND, F.R.S. 287
THE FORM OF COMETS, IV. By M. FAYE (*With Illustrations*) . . 287
THE AMERICAN OYSTER-TRADE 290
RUDE STONE MONUMENTS OR CHAMBERED BARROWS, I By W. C. LUKIS . . . 290
NOTES 293
U.S. WEATHER MAPS 295
SCIENTIFIC SERIALS 296
SOCIETIES AND ACADEMIES 297

John Tyndall.

Engraved by C. H. Jeens from a Photograph

Presented to the Subscribers to "Nature, N° 251 August 20th 1874"

London, Published by Macmillan & C° 1874

THURSDAY, AUGUST 20, 1874

SCIENTIFIC WORTHIES

IV.—JOHN TYNDALL

IN the valleys of Gloucestershire may still be seen a few clothiers' mills, the residue of a once extensive industry. Almost exactly two centuries ago some members of the Tyndall family inhabiting these valleys, and engaged for the most part in this industry, crossed over to the opposite coast of Ireland. This fact, the date of which is fixed by Mr. Greenfield, coupled with family tradition, points to the origin of Prof. Tyndall. In Ireland the Tyndalls fared variously, dividing themselves into magistrates, aldermen, medical men, farmers, and tradesmen. To the last, and indeed to the poorest of the last, Prof. Tyndall's father belonged. He was a man of singular force of intellect and independence of character, and he kept his son at school until his nineteenth year. In accordance with transmitted family habit, Prof. Tyndall, when young, was exercised in all the subtleties of the controversy between Protestantism and Catholicism. In 1839 he quitted school to join a division of the Ordnance Survey, with which he remained connected for nearly five years. His excellent chief, now his intimate friend, General George Wynne, R.E., gave him an opportunity of mastering all the details of the survey, in the office and in the field. For four years subsequently he was engaged on railway work; and while thus employed met Mr. Hirst, who is now the Director of Studies in the Royal Naval College, Greenwich, who afterwards joined him in Marburg, and with whom his relations are more those of a brother than a friend. In 1847, with a view to self-improvement, he accepted a post in Queenwood College, Hampshire, where Dr. Frankland was chemist; and in 1848 they went together to the University of Marburg, Hesse Cassel. Bunsen and others had rendered the little University celebrated; and to Bunsen, whose lectures he attended and in whose laboratory he worked, Prof. Tyndall owes obligations never to be forgotten. He found in Germany a second home. With Stegmann he studied mathematics; he heard Gerling lecture on physics, and subsequently Knoblauch, who, preceded by a distinguished reputation, and accompanied by a choice collection of instruments, came to Marburg as Extraordinary Professor when Tyndall was there. Prof. Knoblauch, in conjunction with whom Tyndall subsequently conducted various inquiries on diamagnetism, supports his old friend and pupil in Belfast; Wiedemann is also there, and Bunsen would have been there if he could. Tyndall subsequently worked in the laboratory of Prof. Magnus in Berlin. In 1851 he accompanied Prof. Huxley to the meeting of the British Association at Ipswich, and thus commenced a friendship which has never faltered to the present hour. Dr. Bence Jones heard of Tyndall in Berlin, and, always alert in the promotion of science and in aiding those who pursued it, had him invited in 1853 to give a Friday evening lecture at the Royal Institution. Soon afterwards, on the proposal of Faraday, Tyndall was appointed Professor of Physics in the Institution, where he still remains.

In 1852 he was one of the secretaries of the Physical Section of the British Association, which then met for the first time in Belfast. Its president was Col. Sabine, to whom Tyndall was indebted in those days for various acts of kindness and encouragement, and who took, unsolicited, charge of his candidature for the Royal Society. But Tyndall's earliest scientific memory happens to be associated with Belfast. In the school to which he was sent in his childhood three different arithmetical treatises were made use of, one written by Gough and another by Voster; but young Tyndall was the only boy in the school who could speak of his *Thomson*. The first germ of science was dropped into Prof. Tyndall's mind by the father of Sir William Thomson, who was then Professor of Mathematics in the Belfast Institution. He also remembers distinctly, many years afterwards, reading in a Glasgow magazine about Davy's experiments on Radiant Heat, and the longing which they excited in him to be able to do something of the kind. With the very apparatus there figured Prof. Tyndall now illustrates his own lectures. In the "Kildare Street Schools," to which he was sent when a little boy, he learned very little, being, indeed, fonder of play than of school. His first serious application to study was under a clever teacher of a national school named John Conwill, with whom he mastered Euclid, some algebra, conic sections, and plane trigonometry. Prof. Tyndall is now about fifty-four years of age. He was born in 1820 in the village of Leighlin Bridge, County Carlow, situated on the Barrow, but a fragmen of which only now remains. When a boy he was expert at climbing trees; he was a good swimmer, a good runner, and though not unfrequently thrashed by an antagonist, a fair fighter. His first mountain experience was among the hills of Westmoreland eight-and-twenty years ago; his first visit to the Alps was in 1849; his second visit, in company with the present President of the Royal Society and Prof. Huxley, was in 1856; and he has continued to visit them every year since. In 1859, having paid his summer visit, he reached the Montanvert at the end of December and determined the winter motion of the Mer de Glace. At the Bel Alp, this year, he prepared his address to the British Association.

That our readers may have the opportunity of knowing the opinion of an eminent continental physicist as to the importance of good popular expositions of scientific subjects, and as to the special talent which Prof. Tyndall has shown in this direction, we give some extracts from a preface to the recently published German translation of Tyndall's "Fragments of Science," which the writer, Professor Helmholtz, has been good enough to revise and send to us for that purpose.

The awakening desire for scientific instruction, ever finding new expression among the educated classes of all European countries, we must consider not merely as a striving after new forms of amusement, or a mere empty and barren curiosity; it is rather a well-justified intellectual necessity, and is in close connection with the most important springs of mental development in these times. The natural sciences have become a powerful influence in the formation of the social, industrial, and political life of civilised nations, not only from the fact that the great forces of nature have been subordinated to the aims of man, and have supplied him

VOL. X.—NO. 251

with a host of new means to attain them; though this mode of their action is sufficiently important that the statesman, the historian, and the philosopher, as well as the manufacturer and the merchant, cannot pass without participation in, at least, the practical results; but because there is another form of their action which goes much deeper and further, though it is, perhaps, more slow in manifesting itself; I mean their influence in the direction of the intellectual progress of humanity. It has often been said, and even brought as a charge against the natural sciences, that, through them, a schism (*zwiespalt*), formerly unknown, has been introduced into modern education. And, indeed, there is truth in this. A schism *is* perceptible; yet such must mark every new step of intellectual development wherever the New has become a power, and the question to be settled is, the definition of its just claims, as against the just claims of the Old. The past progress of education of civilised nations has had its central point in the study of language. Language is the great instrument through possession of which man is most distinctly separated from the lower animals; through use of which he is able to share the experience and knowledge of other individuals of his time, as also those of past generations; without which each man would, like the lower animals, be limited to his instinct and to his own particular experience. That therefore the improvement of language was formerly the first and most necessary work of a growing race, and that the most refined perfection of its comprehension and its use is, and must ever be, the primary problem in the education of each individual, is undoubted. The culture of modern European nations has a peculiarly intimate connection with the study of the remains of antiquity; and thereby, directly with the study of language. With the latter study was associated that of the forms of thought, which are coined in speech; logic and grammar, that is, according to the original meaning of the words, the art of speaking and the art of writing, both taken in the highest sense, have therefore been hitherto the natural hinge points of mental education.

But while language is the means of handing down and preserving truth once recognised, we must not forget that its study teaches nothing as to how fresh truth is to be found. Similarly, logic shows how, from the proposition which forms the major of a syllogism, conclusions are to be drawn; but it can tell us nothing as to whence this proposition has come. He who will convince himself of its independent truth must, on the other hand, begin with knowledge of the individual cases which fall under the law, and which afterwards, if this have been established, may doubtless also be accepted as deductions from the law. But only where a knowledge of the law is one which has been communicated by others, does it actually take precedence of knowledge of the deductions, and in such a case, the treatises of the old formal logic assume their undeniable practical importance.

Thus all these studies do not themselves lead us to the proper source of knowledge—do not bring us face to face with the reality which we seek to know. There is therefore, undoubtedly, a danger in communicating to each one, by preference, a knowledge the source of which he has not personally contemplated. Comparative mythology and the criticism of the metaphysical systems can tell a great deal of how figurative word-expression has in time been exalted to the importance of real knowledge and even become valued as ultimate wisdom.

While fully recognising, then, the significance (not to be sufficiently appreciated) of the finely elaborated art of communicating the acquired knowledge of others, and receiving in return such communications from others, in regard to the mental improvement of our race; while also recognising the importance attaching to the contents of the classical writings, for the cultivation of the moral and æsthetic sentiments, for the development of an intimate knowledge of human feelings, conceptions, and conditions of culture; we must yet hold that an important element is wanting from the exclusively literary-logical mode of education; and that is the methodical discipline of the activity by which we reduce the confused material which meets us in the actual world, apparently (at first sight) ruled by wild chance rather than reason, to clear conception, and thereby make it fit for expression in speech. Such an art of observation and experiment, methodically developed, we have hitherto found in the natural sciences alone; and our hope, that the psychology of individuals and peoples, with the practical sciences of education and of social and political government based upon it, will attain the same end, can only be fulfilled in a distant future.

This new enterprise, prosecuted by natural science on new paths, has quickly enough yielded fresh and, of their kind, unheard-of results, evidencing what achievements human thought is capable of, where it can go the whole way from the facts to the full knowledge of the law under favourable conditions, testing and knowing everything for itself. The simple relations, especially those of inorganic nature, permit of our possessing such a penetrating and accurate knowledge of their laws, such far-reaching deduction of inferences from them, and the testing and verification of these by such an exact reference to fact, that, with the systematic unfolding of such conceptions (*e.g.* with the deduction of astronomical phenomena from the law of gravitation), there is hardly any other edifice of human thought which, for strict logic, certainty, correctness, and productiveness, can at all be compared with it.

I point out these relations merely with the view of showing in what sense the natural sciences are a new and essential element of human education; of indestructible importance, also, for all further development of this in the future; and that a complete education of the individual man, as of nations, will no longer be possible without a union of the past literary-logical with the new natural-science direction of study.

Now, the majority of the educated hitherto have been instructed only in the old way—have hardly at all come into contact with the work of thought in natural science; at the most, perhaps, a little with mathematics. It is men of this kind of education that our Governments appoint, by preference, to educate our children, to maintain reverence for moral order, and to preserve the treasures of knowledge and wisdom of our forefathers. It is they, too, who must organise the changes in the mode of education of the rising generation; where such changes are required they must be encouraged or compelled thereto by the public opinion of the intelligent classes of the whole community, both men and women.

Apart from the natural impulse of every warm-hearted man to lead others to that which he has found to be true and right, there will be in every friend of natural science a strong motive to share in such work, in the reflection that the further development of these sciences themselves, the unfolding of their influence on human education, and, so far as they are a necessary element of this education, the healthiness of the future mental development of the people, depend on an insight being afforded to the educated classes, into the nature and the results of scientific investigation, such as is generally possible, without a personal engrossing occupation with these subjects.

And in proof that the need of such an insight is felt even by those who have grown up under the predominant linguistic and literary instruction, may be cited the large number of popular books of natural science annually published, and the eagerness with which lectures of a popular character on subjects in natural science are attended.

It lies in the nature of the case, however, that the essential part of this want, owing to the depth of its roots, is not easily satisfied. It is true that what science may have established and wrought out in solid results can, by intelligent compilers, be put together and brought into suitable form, so that a reader without previous knowlege of the subject may, with some perseverance and patience, understand it. But such a knowledge, limited to the actual results, is not properly that which we have in view. These books, indeed, compiled with the best intentions, often lead into devious paths. To prevent weariness, they must seek to rivet the attention of the reader by an accumulation of curiosities, whereby the image of science is rendered quite false. One often feels this when the reader begins from his own impulse to tell what he has considered important. Then there are the further objections that the book can give only word-descriptions, or, at the most, drawings representing more or less imperfectly the things and processes of which it treats; and that the reader's power of imagination is thereby subjected to a much greater strain, with much less satisfactory results, than that of the investigator or student who, in museum collections and laboratories, sees the things before him in their living reality. A portion of the difficulties named may readily be obviated in popular lectures, if, at least, some objects or experiments can be shown: the opportunities of doing so in Germany, hitherto, have been mostly very limited.

It appears to me, however, that it is not so much a knowledge of results of scientific investigations in themselves, that the most intelligent and well-educated of the laity ask, but rather a perception of the mental activity of the investigator, of the individuality of his scientific procedure, of the aims at which he strives, of the fresh point of view which his work affords in reference to the great problems of human existence. There can hardly be anything of all this in the properly scientific treatment of scientific objects; on the contrary, the severe discipline of the exact method requires that, in scientific treatises, only that be spoken of which is surely ascertained, hypotheses only where equivalent to the proposal of questions for further investigation, a certain answer to these appearing probable from the next progress of the research. A natural prudence recommends great rigour in this connection. For it is pretty much the same to the greater number even of the instructed hearers whether a man of science says "I know," or "I suppose;" they only ask after the result and the authority by which it is supported, not the grounds or the doubts. It is thus not to be wondered at if earnest investigators do not willingly shock the confidence of their readers in what the former may think true and demonstrable, by the enumeration of ideas of the correctness of which they do not feel themselves quite secure. These may be very probable, and may be expressed with ever so much prudence and careful guardedness; they still expose him who utters them to the danger of vexatious misrepresentation.

It is, further, not to be overlooked, that the peculiar discipline of scientific thought which is necessary for the most abstract and rigorous grasp possible of newly-found ideas and laws, and for the purification from all accidents of the sensuous order of phenomena, along with the habitual residence of the mind among a circle of ideas far removed from general interest, are not quite favourable preparatives for a popular intelligible exposition of the insights obtained, to hearers who have not had the like discipline. For this task there is rather required an artistic talent of exposition, a certain kind of eloquence. The lecturer or writer must find generally accessible standpoints from which he may call forth new representations with the most vivid distinctness, and then allow the abstract principle, which he seeks to make intelligible, to derive from these concrete life. This is almost an opposite mode of treatment to that which obtains in scientific treatises, and it can readily be understood that the men are rare who are equally fitted for both these kinds of intellectual labour.

Owing to all these circumstances a sort of dividing wall is raised between the men of science and the laity who might obtain instruction and guidance from them. That many, and indeed some of the most able, investigators have the qualities and peculiarities belonging to abstract work is natural, and will, in each individual case, be at once willingly excused. I have here merely to guard against the reversal of this relation, as if the defects named were necessary, or at all constituted a prerogative.

The compilers can give no help in those directions where the original thinkers have neglected or avoided expressing themselves. So much the more gratifying is it, I consider, in such a state of things, when, among those who have shown the highest ability for original scientific work, there is found, at times, a man like Tyndall, full of enthusiasm for the problem of making the newly-acquired insights and outlooks of his science available for the wider circle of the people, and, at the same time, endowed with other qualities which are the necessary conditions of success towards this end, eloquence and the gift of lucid exposition.

In England the custom of popular scientific lectures has been much longer in existence than in Germany. Since the constitution of the English Universities is very different from ours, fewer individuals are there in a position to prosecute scientific research, or give scientific instruction to regularly prepared scholars, as their life-calling. This generally makes it much more difficult for individuals to go deeply into a special department of study, though Genius of course everywhere breaks through these and other hindrances. The same circumstance has, on the other hand, maintained a closer connection of the workers in science with all other classes of the population, and incited to a more liberal care for the instruction of the student not regularly trained. While this has hitherto been quite rare in Germany, there have long been in England solid and well-furnished institutions for the purpose.

In the two circumstances, first that in England courses of a moderate number of connected lectures can be delivered, and secondly that this can be done in buildings well suited for demonstrations and experiments of every kind, there is a great advantage over the general custom in Germany, where each lecturer only delivers one lecture.

Now, it is intelligible that during the seventy years since this state of things has arisen, and under so much more favourable external conditions, the English public have educated their lecturers, and the lecturers their public, much better than has hitherto been the case in Germany. The Royal Institution has had, among its professors, two men of the first rank, Sir Humphry Davy and Faraday, who have co-operated to that end. At present Prof. Tyndall is held in peculiarly high esteem, both in England and in the United States, on account of his talent for popular expositions of scientific subjects. Anyone who is conscious within himself of the gift and the power of working in a particular direction for the mental development of humanity, has usually a pleasure in such activity, and is ready to devote to it a good share of his time and his energies. This is especially the case with Prof. Tyndall. He has, therefore, remained true to his post at the Royal Institution, though other honourable posts have been offered him. But it would be quite an erroneous conception to think of him merely as the able, popular lecturer; for the greater part of his activity has always been given to scientific investigation, and we owe to him a series of (in part) highly original and remarkable researches and discoveries in physics and physical chemistry.

In his discourse On the scientific use of the Imagination, delivered before the British Association at Liverpool, Prof. Tyndall has given a peculiarly characteristic description of his manner of intellectual working. There are two ways of searching out the system of laws in nature—that of abstract ideas, and that of thorough experimental research. The former way leads ultimately, through mathematical analysis, to an accurate quantitative knowledge of the phenomena. But it can only advance where the other has already, in some measure, opened up the region, *i.e.* given an inductive knowledge of the laws, at least, for some groups of the phenomena belonging to it, and the point is merely the testing and clearing up of the already found laws, the passage from them to the last and most general laws of the region in question, and the complete unfolding of their consequences. This other way leads to a rich knowledge of the behaviour of natural substances and forces, in which at first the law-element is recognised only in the form in which artists perceive it, through vivid sensuous contemplation of the type of its action, in order to a later working out of it in the pure form of an idea. These two sides of the physicist's work are never quite separate from each other, though sometimes the diversity of individual gifts will adapt one man for mathematical deduction, another for the inductive activity of experimentation. Should the first method, however, become wholly divorced from actual observations, it falls into the danger of laboriously building castles in the air, on unstable foundations, and of not finding the points at which it may verify the agreement of its deductions with fact. The second, on the other hand, would lose sight of the proper aim of science, if it did not work towards ultimately bringing its observations into the precise form of the idea.

The first discovery of laws of nature previously unknown, that is, of new forms of likeness in the course of apparently unconnected phenomena, is a matter of sense (taking this word in its widest meaning), and must nearly always be accomplished only by comparison of numerous sensuous perceptions. The perfection and purification of that which has been found falls afterwards under the working of the deductive method of thinking, and preferentially of mathematical analysis, as the final question is ever about equality of quantities.

Now Mr. Tyndall is *par excellence* an experimenter; he forms his generalisations from extensive observations of the play of natural forces, and carries over what he has seen, in some cases to the greatest, in others to the smallest relations of space (as appeared in the lecture referred to). It is quite a mistake to consider what he calls imagination as mere fancy (*Phantasterei*). It is exactly the opposite that is meant—full sensuous contemplation. To this mode of working is evidently to be attributed the clearness of his lectures on physical phenomena, as also his success as a popular lecturer.

H. HELMHOLTZ

GROVE'S "CORRELATION OF PHYSICAL FORCES"

The Correlation of Physical Forces. Sixth edition. With other Contributions to Science. By the Hon. Sir W. R. Grove, M.A., F.R.S., one of the judges of the Court of Common Pleas. (London: Longmans, 1874.)

THERE are few instances in which anyone whose life has not been exclusively scientific has made such valuable contributions to science as those of Sir W. R. Grove. His nitric acid battery, to the invention of which he was led, not by accident, but by a course of reasoning, which in the year 1839 was as new as it was original, is a contribution to science the value of which is proved by its still surviving and continuing in daily use in every laboratory as the most powerful generator of electric currents, while hundreds of batteries invented since that of Grove have fallen into disuse, and become extinct in the struggle for scientific existence.

The gas battery, though not of such practical importance, is still of great scientific interest, and the collection which we have before us of those contributions to science which took the form of papers, tempts us to indulge in speculations as to the magnitude of the results which would have accrued to science if so powerful a mind could have been continuously directed with undivided energy towards some of the great questions of physics.

But the main feature of the volume is that from which it takes its name, the essay on the Correlation of Physical Forces, the views contained in which were first advanced in a lecture at the London Institution in January 1842, printed by the proprietors, and subsequently more fully developed in a course of lectures in 1843, published in abstract in the *Literary Gazette*. This essay has a value peculiar to itself. Though it has long ago accomplished the main point of its scientific mission to the world, it will always retain its place in the memory of the student of human thought, as one of the documents which serve for the construction of the history of science.

It is not by discoveries only, and the registration of them by learned societies, that science is advanced. The true seat of science is not in the volume of Transactions, but in the living mind, and the advancement of science consists in the direction of men's minds into a scientific channel; whether this is done by the announcement of a discovery, the assertion of a paradox, the invention of a scientific phrase, or the exposition of a system of doctrine. It is for the historian of science to determine the magnitude and direction of the impulse communicated by either of these means to human thought.

But what we require at any given epoch for the advancement of science is not merely to set men thinking, but to produce a concentration of thought in that part of the field of science which at that particular season ought to be cultivated. In the history of science we find that effects of this kind have often been produced by suggestive books, which put into a definite, intelligible, and communicable form, the guiding ideas that are already working in the minds of men of science, so as to lead them to discoveries, but which they cannot yet shape into a definite statement.

In the first half of the present century, when what is now called the principle of the conservation of energy was as yet unknown by name, it "flung its vague shadow back from the depths of futurity," and those who had greater or less understanding of the times sketched out with greater or less clearness their view of the form into which science was shaping itself.

Some of these addressed themselves to the advanced cultivators of science, speaking, of course, in learned phraseology; but others appealed to a larger audience, and spoke in language which they could understand. Mrs. Somerville's book on the "Connection of the Physical Sciences" was published in 1834, and had reached its eighth edition in 1849. This fact is enough to show that there already existed a widespread desire to be able to form some notion of physical science as a whole.

But when we examine her book in order to find out the nature of the connection of the physical sciences, we are at first tempted to suppose that it is due to the art of the bookbinder, who has bound into one volume such a quantity of information about each of them. What we find, in fact, is a series of expositions of different sciences, but hardly a word about their connection. The little that is said about this connection has reference to the mutual dependence of the different sciences on each other, a knowledge of the elements of one being essential to the successful prosecution of another. Thus physical astronomy requires a knowledge of dynamics, and the practical astronomer must learn a certain amount of optics in order to understand atmospheric refraction and the adjustment of telescopes. The sciences are also shown to have a common method, namely, mathematical analysis; so that analytical methods invented for the investigation of one science are often useful in another.

The unity shadowed forth in Mrs. Somerville's book is therefore a unity of the method of science, not a unity of the processes of nature.

Sir W. Grove's essay may be fairly called a popular book, as it has reached its sixth edition. It is, therefore, not merely a record of the speculations of the author, but an index of the state of scientific thought among a large number of readers. It has not the universal facility and occasional felicity of exposition which distinguish Mrs. Somerville's writings. No one could use it as a text-book of any science, or even as an aid to the cultivation of the art of scientific conversation. The design of the book is to show that of the various forms of energy existing in nature, any one may be transformed into any other, the one form appearing as the other disappears. This is what is meant in the essay by the "correlation of the physical forces," and the whole essay is an exposition of this fact, each of the physical forces in turn being taken as the starting-point, and employed as the source of all the others.

We are sorry that we are not at present able to refer to the early reviews of the essay as indicating the reception given to the doctrine by the literary and scientific public at the time of its original publication. It has certainly exercised a very considerable effect in moulding the mass of what is called scientific opinion, that is to say, the influence which determines what a scientific man shall say when he has to make a statement about a science which he does not understand. Many things in the essay which were then considered contrary to scientific opinion, and were therefore objected to, have since then become themselves part of scientific opinion, so that the objections now appear unintelligible to the rising generation of the scientific public.

Helmholtz's essay "On the Conservation of Force," published in 1847, undoubtedly masters a far greater step in science, but the immediate influence was confined to a small number of trained men of science, and it had little direct effect on the public mind.

The various papers of Mayer contain matter calculated to awaken an interest in the transformation of energy even in persons not exclusively devoted to science, but they were long unknown in this country, and produced little direct effect, even in Germany, at the time of their publication.

The rapid development of thermodynamics, and of other applications of the principle of the conservation of energy, at the beginning of the second half of this century, belongs to a later stage of the history of science than that with which we have to do.

To form a just estimate of the value of Sir W. Grove's work we must regard it as the instrument by which certain scientific ideas were diffused over a large area, in language sufficiently appropriate to prevent misapprehension, and yet sufficiently familiar to be listened to by persons who would recoil with horror from any statement in which literary convention is sacrificed to precision.

It is worth while, however, to take note of the progress of evolution by which the words of ordinary language are gradually becoming differentiated and rendered scientifically precise. The fathers of dynamical science found a number of words in common use expressive of action and the results of action, such as force, power, action, impulse, impetus, stress, strain, work, energy, &c. They also had in their minds a number of ideas to be expressed, and they appropriated these words as they best could to express these ideas. But the equivalent words Force, *Vis*, *Kraft*, came most easily to hand, so that we find them compelled to carry almost all the ideas above mentioned, while the other words which might have borne a portion of the load were long left out of scientific language, and retained only their more or less vague meanings as ordinary words.

Thus we have the expressions *Vis acceleratrix*, *Vis motrix*, *Vis viva*, *Vis mortua*, and even *Vis inertiæ*, in every one of which, except the second and fourth, the word *Vis* is used in a sense radically different from that in which it is used in the other expressions.

Confusion may perhaps be avoided in scientific works when read by scientific students, by means of a careful appropriation of epithets such as those which distinguish the meanings of the word *Vis*, but as soon as science becomes popularised, unless its nomenclature is reformed and arranged upon a better principle, the ideas of popular science will be more confused than those of so-called popular ignorance.

Thus the "Physical Forces," whose correlation is discussed in the essay before us, are Motion, Heat, Electricity, Light, Magnetism, Chemical Affinity, and "other modes of force." According to the definition of force, as it has been laid down during the last two centuries in treatises on dynamics, not one of these, except perhaps chemical affinity, can be admitted as a force. According to that definition, "force is that which produces change of motion, and is measured by the change of motion produced."

Newton himself reminds us that force exists only so long as it acts. Its effects may remain, but the force itself is essentially transitive. Hence, when we meet with such phrases as Conservation of Force, Persistence of Force, and the like, we must suppose the word Force to be used in a sense radically different from that adopted by scientific men from Newton downwards. In all these cases, and in the phrase "The Physical Forces" as applied to heat, we are now, thanks to Dr. Thomas Young, able to use the word Energy instead of Force, for this word, according to its scientific definition as "the capacity for performing work," is applicable to all these cases. The confusion has extended even to the metaphorical use of the word Force. Thus, it may be a legitimate metaphor to speak of the force of public opinion as being brought to bear on a statesman so as to exert an overpowering pressure upon him, because here we have an action tending to produce motion in a particular direction; but when we speak of "the Queen's Forces," we use the term in a sense as unscientific as when we speak of the Physical Forces. The author, in his concluding remarks, points out the confusion of terms which embarrassed him in his endeavours to enunciate scientific propositions, on account of the imperfection of scientific language. This, he tells us, "cannot be avoided without a neology which I have not the presumption to introduce or the authority to enforce."

Such a confession, proceeding from so great a master of the art of "putting things," is a most valuable testimony to the importance of the study and special cultivation of scientific language; and a comparison of many passages in the essay with the corresponding statements in more recent books of far inferior power, will show how much may be gained by the successful introduction of appropriate neologies. What appeared mysterious and even paradoxical to the giant, labouring among rough-hewn words, dwindles into a truism in the eyes of the child, born heir to the palace of truth, for the erection of which the giant has furnished the materials.

Thus the appropriation of the word "Mass" to denote the quantity of matter as defined by the amount of force required to produce a given acceleration, has placed the students of the present day on a very different level from those who had to puzzle out the meaning of the phrase *Vis Inertiæ* by combining the explanation of *Vis* as force, with that of *Inertia* as laziness. In the same way the word "stress" as an equivalent for "action and reaction," and as a generic name for pressure, tension, &c., will save future generations a great deal of trouble; and the distinction between the possession of energy and the act of doing work, which is now so familiar to us, would have obviated several objections to the doctrine of the essay, which are founded on statements in which the production of one form of energy and the maintenance of another are treated as if they were operations of the same kind. We read at p. 163:—Thus, "a voltaic battery, decomposing water in a voltameter, while the same current is employed at the same time to make (maintain) an electro-magnet, gives nevertheless in the voltameter an equivalent of gas, or decomposes an equivalent of an electrolyte for each equivalent of decomposition in the battery cells, and will give the same ratios if the electro-magnet be removed."

Here the maintenance of a magnet is a thing of a different order from the decomposition of an electrolyte; the first is maintenance of energy, the other is doing work. This is well explained in the essay; but if appropriate language had been used from the first, the objection could never have been put into form.

J. C. CLERK-MAXWELL

FIRST FORMS OF VEGETATION

First Forms of Vegetation. By the Rev. Hugh Macmillan, LL.D. Second edition, corrected and revised. (London: Macmillan and Co.)

DR. MACMILLAN explicitly informs his readers in his preface to his book, that his object is not so much to impart cut-and-dried information as to kindle their sympathy and awaken their interest "in a department of nature with which few, owing to the technical phraseology of botanical works, are familiar." Such a purpose is very laudable indeed, and the book which carried it into effect might have been a very valuable one. Science has great need of evangelists. Students of its various branches experience the keenest interest in following up the lines of research and investigating the problems which belong to their own departments. But to feel this interest it is necessary to be instructed; and in an immense number of cases it is impossible to convey in non-technical language, so as to be understood by the uninstructed, in what the interest consists. Hence it follows that a large number of scientific workers have conceived a decided contempt for all attempts to popularise science. Their position is so far sound. Still, it is extremely important in the interests of science itself that its investigations should not be wholly withdrawn from the notice of the general community and confined to a small esoteric class. Here the function of the evangelists needs to be properly recognised; we want men with Dr. Macmillan's sympathy with the subject-matter and liking for exposition to take a wider view of it in respect to general interest than it will ever be possible for the special student to take. If public funds are to be devoted to scientific purposes, it is absolutely necessary that the public mind should have some idea that they are being expended on something of more general importance than individual hobbies, as they will be too apt to believe, unless their sympathy with the work is occasionally kindled. It is not every branch of science which is capable of yielding results which can at once be turned to commercial profit, and though knowledge in every line of investigation may be expected to yield practical applications in the most unexpected directions, it would be an evil time for scientific advancement when the community determined to shut its eyes and close its ears to everything which could not be shown to pay. It is very likely, however, to begin to do this unless scientific men take measures to excite intelligent interest where there is no obvious suggestion of profit to gratify the natural cupidity of a commercial country.

It is worth while making these remarks, because it deserves to be borne in mind that the work—though apt to be contemned—is not easy to do; nor is it easy to find men fit to do it. And the criticisms which we shall now proceed to make on Dr. Macmillan's book are made by no means from a desire to find fault, but rather to bring into prominence the inherent difficulty which exists in writing such a book as it should be written. If the author has not had a thorough drilling in the technicalities of the subject, then, as Dr. Macmillan has done, he will make some exceptionable statements and stray into sundry grievous pitfalls. If, on the other hand, he is quite and fully competent to write the book, it is tolerably certain he will never write it at all. The general reader wants his science skimmed for him—and this is an operation which a competent student particularly dislikes to perform.

It is a pity that some of Dr. Macmillan's friends "whose scientific position lends weight to their opinions" did not assist him in issuing the work in its new form. This in fact seems to be the only chance of doing the thing properly. The aid of those who would not actually write such books might at any rate be given for the purpose of keeping them free from glaring blunders.

Mosses, for example, we are told (p. 27) belong to the highest division of flowerless plants. This statement can only be met by a categorical negative. As to their being "prefigurations of the flowering plants, epitomes of archetypes in trees and flowers," if this is the alternative for technical language, the general reader can hardly be congratulated on the change. But the author seems not to have a very clear conception of the structural rank of mosses. He tells us on the next page that "through the cone like spikes of the club-mosses they approximate to the pine tribe in their fructification." This is a *rapprochement* which no modern systematist would think of making. In fact, mosses and club-mosses have the same kind of relationship and no more that ants have with white ants or the albumen of an egg with the albumen of a seed.

On p. 37 it takes one's breath away to read, "*Besides* these curious capsules there are other organs of fructification which clearly demonstrate the sexuality of mosses." It hardly at first occurs to the reader that the author has no notion that the capsules are really the fertilised product derived from the sexual apparatus. The capsule—and this is one of the most remarkable things in the whole vegetable kingdom—is gradually developed from the oospore; its being composed of modified leaves, as Dr. Macmillan explains on p. 40, is an antiquated idea. There is something indeed to strike an intelligent curiosity on almost every page. At p. 80 we are told of Lycopods "becoming slightly aborescent in tropical countries, *particularly* New Zealand." On p. 84 "some species" are said "to have little conelike spikes at the tips of their branches under the scales of which, as in the pine tribe, lurk the reproductive embryos." This is simply utter nonsense. In so far as the process is understood we have spores borne in spore cases at the base of the upper surface of the fruiting scales, and these spores when disseminated undergo a further process of development, which results in the formation of an embryo.

Dr. Macmillan dismisses Schwenderer's theory of lichens in a very *ex cathedrâ* fashion. *En revanche*, he is equally decided in rejecting Dr. Bastian's views on heterogenesis.

We regret that this book has not been put into a more satisfactory shape, for the author has industriously collected a great deal of very interesting matter.

W. T. T. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Bright Meteors

On Saturday last I saw *two* very bright meteors, each coming from the Perseus radiant point, and isolated from smaller ones by such a length of time that my (possible) watch error of perhaps one minute will not prevent their being identified if they have been observed at other stations.

A very bright one, almost like a rocket, passed exactly over Vega at 10.35.

Another, nearly as bright, passed through the intersection of the diagonals of the quadrilateral of Monoceros at 10.55.

P. G. Tait

St. Andrew's, N.B., Aug. 13

Mr. Herbert Spencer and Physical Axioms

I cannot help thinking that something of importance *still* remains to be said on the subject of the laws of motion, recently argued in your columns with so much ability by Spencer, Tait, and others.

There are three species of magnitude, viz., number, extended magnitude, and magnitude of degree. Magnitude of degree admits in itself no other mathematical comparison than that of equality and inequality, and no other mathematical treatment than simple increase or decrease, and in consequence it does not admit directly of ordinary mathematical investigation. Number and extended magnitude, such as length, duration, &c., admits of comparison by ratio, and of addition, subtraction, multiplication, division, &c. Magnitudes of degree are only brought under mathematical processes by means of conventional measurement. That is to say, some number or extended magnitude, which is found by experience to vary with the magnitude of degree, is adopted eventually as the measure of that magnitude, and mathematical processes are applied to the measure. It is incorrect, however, to say that we take an extended magnitude which varies in direct proportion with the magnitude of degree, as its measure, because direct proportion of magnitudes which vary together involves inequality of ratio of corresponding value, and, as already stated, the proportion of ratio does not really subsist between different values of a magnitude of degree, though from the intimate mental connection between certain magnitudes of degree and their measures, we often think it does.

When, for instance, we say that the brightness of two equal lights is double that of either, the statement is quite incapable of proof by experiment, and is certainly not intuitional; it is simply conventional. If we agreed that the brightness of a number of equal lights should be measured by the square root of the number, we should have to consider that the brightness of light varies inversely as its distance instead of as the square of its distance from its origin—a result against which nothing could be urged but its practical inconvenience. Or, to take the example of a magnitude of degree whose conventional movement is somewhat less familiar to our minds: when we say that our expectation of an event which happens on an average three out of four times is double of our expectation of an event which happens once out of four times, we are clearly using words in a conventional way. The one belief is not really double of the other, but the average by which we agree to measure it is double.

Now with respect to force and mass, both magnitudes of degree, it so happens that there are two almost equally natural methods of measuring them consistent with, but nevertheless independent of, each other. Each of these may be conventionally adopted, but in either case its consistence with the other can only be demonstrated by experiment.

If you agree to measure force as directly proportionate to the acceleration it produces on a given mass, and mass as inversely proportionate to the acceleration produced by a given force, then, to that extent, the second law of motion, and the law which is sometimes adopted in place of Newton's third, are the results neither of experience nor intuition, but simply of convention; but then, on the other hand, it must be held that it is by experience we come to the conclusion that the mass of two bodies, *as above measured*, is the sum of their two masses, and the weight of two bodies the sum of their weights. If, on the other hand, you conventionally measure forces by the number of equal weights which will produce the same effect, and masses by the number of bodies of equal mass which make them up, then clearly the truth of the above portion of the laws of motion can only be proved by experience.

The mistake made by some mathematicians is that while ostensibly assuming the one conventional measure of force and mass they tacitly assume the other, and then illogically profess to demonstrate the necessary consequences of their own conventions by reference to experience founded on the other. They agree to measure force by the acceleration it produces in its own direction on a given mass, and then profess to prove forces do produce such proportionate acceleration by reference to experience, on the assumption that forces are to be measured by the number of equal weights or other forces which will produce the same effect.

In the case of the first law of motion, mathematicians often commit an error even more flagrant. To define force as that which affects motion, and then to profess that it is proved by experience that a body acted on by no force will remain at rest or move uniform, is on the face of it absurd. As well might Euclid, after defining a circle, have appealed to experience to show that a figure, every point of whose circumference is not equally distant from the centre, is not a circle. Or as well might a doctor begin by defining intoxication to be a state produced by taking alcohol, and then appeal to the experience of the Good Templars to prove that in the absence of alcohol there is no intoxication.

Herbert Spencer seems to me to be wrong, therefore, in concluding that our belief in the laws of motion is in the true sense (if it has any true sense) intuitive; but his error is the more excusable on account of the confusion of ideas involved in most mathematical explanations of these laws.

F. GUTHRIE

Graaff Reinet College, Cape of Good Hope, June 21

ORGANISATION OF THE FRENCH METEOROLOGICAL SERVICE

THE measures we alluded to in NATURE, vol. x. p. 294, with respect to the French Meteorological Service, have been partially adopted, and will be shortly followed by others. The Meteorological Service has been divided between two astronomers—M. Rayet, who has under his special care the magnetical map of France, the official observations taken at the observatory, and the several French stations; and M. Froat, who has been appointed to investigate the great disturbances of the atmosphere, to send warnings to the principal French seaports, to publish the atlas, and correspond with the several departmental commissions which have been already appointed. These departmental commissions are appointed by the prefect of each department, and funds are granted to them out of the departmental budget and voted by the Council-General of each department.

M. Leverrier issued, on August 5, a circular to these general commissions, informing them that the printing of the storm-maps, which had been stopped owing to the country's calamities, was to be resumed.

Special mention is made in this circular of the hailstorms which have been studied most carefully by MM. Becquerel, father and son. Nothing has been done yet to increase the efficiency of lightning conductors.

The several departmental commissions, numbering about ninety, including Algiers, have been grouped into six natural regions. M. Ch. Sainte-Clair Deville has been sent to Algiers to organise the meteorology of that country, from the sea to the remotest parts of the French possessions in the desert. He has not finished his tour yet. He is General Inspector for Meteorology, and had issued an order for altering the hours of observation, which order was cancelled by the Ministry.

Some arrangements have yet to be made with the navy for the storm warnings. Very likely French seaports will continue to receive warnings from England, which are very popular, as well as warnings from their own observatory.

NOTES

MR. BRIAN HODGSON, F.Z.S., has presented to the library of the Zoological Society a large collection of original drawings of Himalayan Mammals, made during his residence in Nepaul. They are of much scientific value, as being in many cases taken from the types on which his species are founded.

M. MAREY has recently published the results of experiments undertaken to determine by the graphic method what is the true movement of the legs in walking. His results prove convincingly that the brothers Weber were wrong in assuming that the oscillation of the leg which is not in contact with the ground is the same as that of a pendulum; for when it is represented on a uniformly moving plane, the line drawn is a straight and not a curved one. The movement of the suspended foot is therefore uniform, depending on muscular action, in combination with that of gravity.

DR. MORRISON WATSON, Senior Demonstrator of Anatomy in the University of Edinburgh, has been appointed Professor of Anatomy in the Owens College, Manchester.

A PARTICULARLY closely reasoned and valuable paper has just been published by Dr. William Marcet, F.R.S., entitled "An Experimental Inquiry into the Nutrition of Animal Tissues," in which the author argues out, and substantiates by careful analysis, his division of the constituents of animal tissues into the parts which constitute the working or ripe tissue, insoluble in water; the nutritive material of the tissue, colloid and soluble; and the products of tissue-destruction, crystalloid and soluble. We hope to be able to give an abstract of this paper on a future occasion.

Les Mondes announces the death, on July 21, of Count Gustave Doulcet de Pontécoulant, who was born in 1798.

THE seventh session of the International Congress of Anthropology and Prehistoric Archæology was closed at Stockholm on Sunday, after having fixed on Buda-Pesth as the next place of meeting. The number of members of this Association is upwards of 1,550: of these, 800 were present at the Stockholm meeting, which commenced on the 7th instant, when the following officials were chosen:—Patron, Oscar II., King of Sweden and Norway; president, Count Hammig Hamilton, Grand Chancellor of the Swedish Universities; honorary presidents, MM. Desor, Capellini, and Worsaae; vice-presidents, MM. Hildebrandt, sen., and Nilsson (Sweden), De Quatrefages (France), Franks (England), Virchow (Germany), Dupont (Belgium), Leemans and Bogdanow (Russia); general secretary, M. Hans Hildebrandt; secretaries, MM. Montelius, Retzius, Chantre, and Cazalis de Fondouce; assistant secretaries, MM. Stolpe and Landberg; council, MM. Bertrand, Berthelot, Evans, Von Quast, Schaffhausen, Pigorini, Van Beneden, Engelhardt, Rygh, Von Duben, Aspelin, Lerch, Romer, Whitney. The sittings were held at the *Riddarhus*, or "House of Knights," a house as old as the time of Gustavus Adolphus, which belongs to the Swedish nobility. Stockholm was very appropriately fixed upon as the place of meeting for this year's Congress, as the northern antiquaries and archæologists have done a great deal to form the departments of research with which the Congress deals; we need only mention the names of Bruzelius, Thomsen (Denmark), Nilsson, Retzius, and Hildebrandt. The magnificent museum of Stockholm was commenced in 1850, and finished in 1863, and the collection has been arranged by the Government Antiquary, M. Hildebrandt, and is one of the finest collections of prehistoric archæology in existence. Both the King and the city of Stockholm gave the antiquaries a splendid welcome.

THE British Medical Association meets next year in Edinburgh, the president-elect being Prof. Sir Robert Christison, Bart.

A NEW physiological laboratory, and also an addition to the chemical laboratory of Westminster Hospital, are rapidly approaching completion.

AT the meeting of the Paris Academy of Sciences on the 10th inst., a letter from the Minister of Public Instruction was read, informing the Academy that in consequence of the proposition made to the National Assembly in the month of July last to establish in the neighbourhood of Paris a Physical Observatory independent of the Astronomical Observatory, it was decided to consult the Academy as to the appropriateness and utility of such an establishment. The Minister requested the Academy to consider the question and let him know what conclusion they came to.

WITH reference to Prof. Newcomb's investigation of the moon's motion, the superintendent of the U.S. Naval Observatory reports that the work has been nearly accomplished and prepared for the press according to the original plan; but on examining certain terms troublesome to calculate, which it was supposed were entirely unimportant, it was found that the work could not be properly completed without them. The preparations for observing the transit of Venus have interfered with the development of these important terms. The second part of the work, namely, the tables founded upon Prof. Newcomb's theory, has been carried as far as it can be without the data that will be attainable as soon as the preparations for observing the transit of Venus are completed.

ADMIRAL SANDS, in his annual report in reference to the work of the U S Naval Observatory, states that observations, to be of any value to the world, must be published. If they are not, the time and labour spent upon them are simply wasted; and yet they are so much more easily made than reduced, that nothing is more common than to see them lie for years before the computations necessary to fit them for publication are completed. The Naval Observatory has been enabled to resuscitate from its store-rooms the zones of stars observed by Capt. Gilliss, in Chili, in 1850-52, and their reductions are now in such a state of forwardness that the resulting star catalogue will appear in the volume of Washington Observations for 1873. Thus it will be seen that nearly all the valuable observations which were at one time locked up in the archives of the Observatory have been given to the world.

WE notice with much pleasure that the Society of Arts has issued a prospectus of Examinations in the Technology of Agriculture and Rural Economy, proposed to be held annually by the Society, as a part of its excellent system of technological examinations in the various industries of the country. We sincerely hope that the proposed examinations will be largely the means of carrying out the object which the Society has in view in instituting them, viz., the promotion of a more extended and intelligent study of agriculture and of the sciences bearing upon it, by those intending to adopt farming as an occupation. The examinations will consist of three parts:—(1) General Science, in which a very wide knowledge of the various sciences which lie at the basis of successful agriculture is demanded from the candidates: there are three certificates in this department—the Elementary Certificate, the Advanced Certificate, and Honours. (2) Technology, in which a knowledge of the many points connected with agriculture and rural economy will be demanded from the candidates proportioned to the class in which they may have passed in the previous examinations: this examination looks very formidable on paper, and to pass creditably it will demand extensive reading and hard work on the part of the candidates. (3) Practical Knowledge: under this head the candidate must forward to the Society of Arts a certificate, on a form supplied, signed by some agriculturist with whom he may have been practically engaged in farming operations, showing that he has a practical acquaintance with the subject. In order to render these examinations really useful, the Council are making application to the Agricultural Societies, local and general, for assistance in founding scholarships for successful candidates to undergo a regular course of instruction at an Agricultural College. We hope the scheme of the Society of Arts will be productive of excellent results on the agriculture of the country.

M. RENAN has brought out a new work, "La Mission de Phénicie," being an account of the scientific researches in Syria during the sojourn of the French army in 1860-61.

A COMMITTEE has been formed to consider what means ought to be taken for the construction of an aquarium at Herne Bay.

PROF. GERVAIS (U.S.) has made a communication upon the teeth of the American reptile known as *Heloderma*. A species of the genus is abundant in Southern Arizona, where it is called a scorpion, and is reputed by the natives to be extremely venomous, although experiments carefully prosecuted by Dr. B. J. D. Irwin, of the United States Army, failed to exhibit any evidence of this fact. There is, as Gervais and others have found, a striking relationship between it and some of the poisonous serpents in the possession of a longitudinal furrow on the back part of the teeth, as if to carry poison from a gland. Whether the animal be actually poisonous or not, Gervais calls attention to the peculiar structure of the teeth (as shown by the microscope in a cross section), the basal part of which is filled by folds or plications directed outward toward the fine exterior coat of enamel.

Two new medical bi-monthly journals come to us from Paris; one, the *Paris Medical Record*, is in English, and in general appearance and arrangement resembles the *London Medical Record*; its declared intention is to supplement the efforts of other medical journals. The other, *Echo de la Presse Médicale*, is intended as the complement of the above, and is to be published every alternate week.

The Wheeler U.S. Expedition started from Washington to concentrate at Pueblo, Colorado, on July 15, leaving there as soon thereafter as the different parties can be got into shape. It will move in three separate divisions, which will occupy portions of South-western Colorado and Northern New Mexico. The principal localities to be examined are south of the thirty-eighth parallel of north latitude, in the neighbourhood of the Rio San Juan, and the northern tributaries of the Rio Grande, Rio Chamas, Pecos, and Canadian, a region extremely interesting, and which must shortly be opened up for mining purposes. There will be two separate astronomical parties, one in charge of Mr. John H. Clark, with one assistant, at the observatory, Ogden, Utah; the other in charge of Dr. F. L. Kampf, who will have two assistants, and will occupy stations at Las Vegas, Cimmaron, Sidney Barracks, Julesburgh, and the crossing of the Union Pacific Railroad at the one hundredth meridian. In New Mexico there will be a special party operating, consisting of Prof. E. D. Cope, palæontologist, and Dr. H. C. Yarrow, naturalist of the survey, and one assistant. These gentlemen will visit certain specified areas in the valley of the Rio Grande and Rio San Juan. The main division will be in charge of Lieut. Wheeler, assisted by Lieut. C. W. Whipple and six civilian assistants. The first party of the first division will be in charge of Lieut. W. L. Marshall, assisted by three civilian assistants. The second party consists of Lieut. Rogers Birnie and five civilian assistants. The second division of the first party, Lieut. P. M. Price and four civilian assistants; second party, Lieut. S. E. Blunt and three civilian assistants. There is also a special natural history party, at present operating in portions of Arizona and New Mexico, consisting of Dr. J. T. Rothrock, botanist, Prof. H. W. Henshaw, ornithologist, and James Rutter, general collector. Dr. Oscar Loew will accompany the expedition as chemist and mineralogist, and will be assigned to one of the above-named sections. The entire expedition is made up of nine different parties, and will cover a wide and interesting field; and it is hoped that our geographical knowledge, in the broadest sense of the word, will be greatly augmented by its labours and investigations. Mr. Henshaw and his associates of the special party, above referred to, have been heard from in the vicinity of Fort Wingate, New Mexico, where they were making the best of their way south. They have already secured extensive collections of specimens, and a box has been received at the Washington office containing a number of bird-skins, Indian crania, fish, reptiles, insects, plants, &c. This party will proceed south to near the Mexican boundary, and then retrace their steps, disbanding at Santa Fé in the fall.

In a paper reprinted from the *American Journal of Science and Arts*, On the connection between isomorphism, molecular weight, and physiological action, by James Blake, M.D., the author gives the following results of investigations on the action of substances when introduced into the veins or arteries of living animals:—1. In the changes induced in living matter by inorganic compounds, the character of the change depends more on the physical properties of the reagent than on its more purely chemical properties. 2. That the character of the changes is determined by the isomorphous relations of the electro-positive element of the reagent. 3. That among the compounds of the more purely metallic elements, the quantity of substances in the same isomorphous group required to produce analogous changes in living matter, is less as the atomic weight of the electro-positive element increases. 4. That the action of inorganic compounds on living matter appears not to be connected with the changes they produce in the proximate elements of the solids and fluids, when no longer forming part of a living body, at least in so far as our present means of research enable us to judge. 5. That in living matter we possess a reagent capable of aiding us in our investigations on the molecular properties of substances.

There have been found in the Warora district, Central India, in a coalfield of about 1,000 acres, two seams, one 15 ft. and the other 20 ft. thick, close together. In other parts the seam is from 50 ft. to 60 ft. thick. It is also said there are millions of tons of iron ore yielding 70 per cent. of metallic iron.

Among other recent interesting announcements is that by Mr. O. Harger of the discovery in the coal measures of Illinois of a fossil spider, to which the name *Arthrolycosa antiqua* has been applied.

The telegraphic apparatus at the U.S. Naval Observatory at Washington is now connected with the main lines of the Western Union Telegraph Company, so that not only is the time-ball dropped daily at noon, but the same signal is widely distributed by the telegraph company. It goes directly from the observatory to the main office in New York city, and thence it is sent to nearly every State in the Union. The immediate object of these signals is to furnish accurate and uniform time to the railroads, and throughout the whole of the vast territory in question there is scarcely a train whose movements are not regulated by the observatory clocks. The clocks at the Navy Department, at the Army Signal Office, at the Treasury Department, and at the Western Union Telegraph Company's office are all constructed on the system known as Hamblett's, and are directly controlled by electric currents sent every second by the standard clock at the observatory.

The additions to the Zoological Society's Gardens during the past week include a Puma (*Felis concolor*), and three Kinkajous (*Cercoleptes caudivolvulus*), from South America, presented by Mr. W. Delisle Powles; a Cuvier's Toucan (*Ramphastos cuvieri*), from Brazil, presented by Mr. Philip Harrington; a Macaque Monkey (*Macacus cynomolgus*), white variety, from India, presented by Sir Andrew Clarke; a West African Python (*Python sebæ*), deposited; a Crested Agouti (*Dasyprocta cristata*), from South America; five common Kingfishers (*Alcedo ispida*), British, purchased.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The forty-fourth Annual Meeting of the Association was opened yesterday at Belfast, when Prof. A. W. Williamson resigned the Presidency to Prof. Tyndall, who delivered the opening Address.

As in former years, we are able, by the courtesy of the officers of the Association, to publish this week the Address of the President of the Association, and the Addresses of some of the Presidents of Sections.

INAUGURAL ADDRESS OF PROF. JOHN TYNDALL, D.C.L., LL.D., F.R.S., PRESIDENT.

AN impulse inherent in primeval man turned his thoughts and questionings betimes towards the sources of natural phenomena. The same impulse, inherited and intensified, is the spur of scientific action to-day. Determined by it, by a process of abstraction from experience we form physical theories which lie beyond the pale of experience, but which satisfy the desire of the mind to see every natural occurrence resting upon a cause. In forming their notions of the origin of things, our earliest historic (and doubtless, we might add, our prehistoric) ancestors pursued, as far as their intelligence permitted, the same course. They also fell back upon experience, but with this difference—that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of nature, but from what lay much closer to them, the observation of men. Their theories accordingly took an anthropomorphic form. To supersensual beings, which, "however potent and invisible, were nothing but a species of human creatures, perhaps raised from among mankind, and retaining all human passions and appetites,"* were handed over the rule and governance of natural phenomena.

Tested by observation and reflection, these early notions failed in the long run to satisfy the more penetrating intellects of our race. Far in the depths of history we find men of exceptional power differentiating themselves from the crowd, rejecting these anthropomorphic notions, and seeking to connect natural phenomena with their physical principles. But long prior to these purer efforts of the understanding the merchant had been abroad, and rendered the philosopher possible; commerce had been developed, wealth amassed, leisure for travel and for speculation secured, while races educated under different conditions, and therefore differently informed and endowed, had been stimulated and sharpened by mutual contact. In those regions where the commercial aristocracy of ancient Greece mingled with its eastern neighbours, the sciences were born, being nurtured and developed by free-thinking and courageous men. The state of things to be displaced may be gathered from a passage of Euripides quoted by Hume. "There is nothing in the world; no glory, no prosperity. The gods toss all into confusion; mix everything with its reverse, that all of us, from our ignorance and uncertainty, may pay them the more worship and reverence." Now, as science demands the radical extirpation of caprice and the absolute reliance upon law in nature, there grew with the growth of scientific notions a desire and determination to sweep from the field of theory this mob of gods and demons, and to place natural phenomena on a basis more congruent with themselves.

The problem which had been previously approached from above was now attacked from below; theoretic effort passed from the super- to the sub sensible. It was felt that to construct the universe in idea it was necessary to have some notion of its constituent parts—of what Lucretius subsequently called the "First Beginnings." Abstracting again from experience, the leaders of scientific speculation reached at length the pregnant doctrine of atoms and molecules, the latest developments of which were set forth with such power and clearness at the last meeting of the British Association. Thought no doubt had long hovered about this doctrine before it attained the precision and completeness which it assumed in the mind of Democritus,† a philosopher who may well for a moment arrest our attention "Few great men," says Lange, in his excellent "History of Materialism," a work to the spirit and the letter of which I am equally indebted, "have been so despitefully used by history as Democritus. In the distorted images sent down to us through unscientific traditions there remains of him almost nothing but the name of the 'laughing philosopher,' while figures of immeasurably smaller significance spread themselves at full length before us." Lange speaks of Bacon's high appreciation of Democritus—for ample illustrations of which I am indebted to my excellent friend Mr. Spedding, the learned editor and biographer of Bacon. It is evident, indeed, that Bacon considered Democritus to be a man of weightier metal than either Plato or Aristotle, though their philosophy "was noised and celebrated in the schools, amid the din and pomp of professors." It was not they, but Genseric and Attila and the barbarians, who destroyed the atomic philosophy. "For at a time when all human learning had suffered shipwreck, these planks of Aristotelian and Platonic philosophy, as being of a lighter and more inflated substance, were preserved and come down to us, while things more solid sank and almost passed into oblivion."

The principles enunciated by Democritus reveal his uncompromising antagonism to those who deduced the phenomena of nature from the caprices of the gods. They are briefly these:—1. From nothing comes nothing. Nothing that exists can be destroyed. All changes are due to the combination and separation of molecules. 2. Nothing happens by chance. Every occurrence has its cause from which it follows by necessity. 3. The only existing things are the atoms and empty space; all else is mere opinion. 4. The atoms are infinite in number, and infinitely various in form; they strike together, and the lateral motions and whirlings which thus arise are the beginnings of worlds. 5. The varieties of all things depend upon the varieties of their atoms, in number, size, and aggregation. 6. The soul consists of free, smooth, round atoms, like those of fire. These are the most mobile of all. They interpenetrate the whole body, and in their motions the phenomena of life arise. Thus the atoms of Democritus are individually without sensation; they combine in obedience to mechanical laws; and not only organic forms, but the phenomena of sensation and thought are also the result of their combination.

That great enigma, "the exquisite adaptation of one part of an organism to another part, and to the conditions of life," more especially the construction of the human body, Democritus made no attempt to solve. Empedocles, a man of more fiery and poetic nature, introduced the notion of love and hate among the atoms to account for their combination and separation. Noticing this gap in the doctrine of Democritus, he struck in with the penetrating thought, linked, however, with some wild speculation, that it lay in the very nature of those combinations which were suited to their ends (in other words, in harmony with their environment) to maintain themselves, while unfit combinations, having no proper habitat, must rapidly disappear. Thus more than 2,000 years ago the doctrine of the "survival of the fittest," which in our day, not on the basis of vague conjecture, but of positive knowledge, has been raised to such extraordinary significance, had received at all events partial enunciation.*

Epicurus,† said to be the son of a poor schoolmaster at Samos, is the next dominant figure in the history of the atomic philosophy. He mastered the writings of Democritus, heard lectures in Athens, returned to Samos, and subsequently wandered through various countries. He finally returned to Athens, where he bought a garden, and surrounded himself by pupils, in the midst of whom he lived a pure and serene life, and died a peaceful death. His philosophy was almost identical with that of Democritus; but he never quoted either friend or foe. One main object of Epicurus was to free the world from superstition and the fear of death. Death he treated with indifference. It merely robs us of sensation. As long as we are, death is not; and when death is, we are not. Life has no more evil for him who has made up his mind that it is no evil not to live. He adored the gods, but not in the ordinary fashion. The idea of divine power, properly purified, he thought an elevating one. Still he taught, "Not he is godless who rejects the gods of the crowd, but rather he who accepts them." The gods were to him eternal and immortal beings, whose blessedness excluded every thought of care or occupation of any kind. Nature pursues her course in accordance with everlasting laws, the gods never interfering. They haunt

> "The lucid interspace of world and world
> Where never creeps a cloud or moves a wind,
> Nor ever falls the least white star of snow,
> Nor ever lowest roll of thunder moans,
> Nor sound of human sorrow mounts to mar
> Their sacred everlasting calm" ‡

Lange considers the relation of Epicurus to the gods subjective; the indication probably of an ethical requirement of his own nature. We cannot read history with open eyes, or study human nature to its depths, and fail to discern such a requirement. Man never has been and he never will be satisfied with the operations and products of the understanding alone; hence physical science cannot cover all the demands of his nature. But the history of the efforts made to satisfy these demands might be broadly described as a history of errors—the error consisting in ascribing fixity to that which is fluent, which varies as we vary, being gross when we are gross, and becoming, as our capacities widen, more abstract and sublime. On one great point the mind of Epicurus was at peace. He neither sought nor expected, here or hereafter, any personal profit from his relation to the gods. And it is assuredly a fact that loftiness and serenity of thought may be promoted by conceptions which involve no idea of profit of this kind. "Did I not believe," said a great man to me once, "that an Intelligence is at the heart of things, my life on earth would be intolerable." The utterer of these words is not, in my opinion, rendered less noble but more noble, by the fact that it was the need of ethical harmony here, and not the thought of personal profit hereafter, that prompted his observation

---

* Hume, "Natural History of Religion."

† Born 460 B.C.

* Lange, 2nd edit., p. 23

† Born 342 B.C.

‡ Tennyson's "Lucretius."

A century and a half after the death of Epicurus, Lucretius* wrote his great poem, "On the Nature of Things," in which he, a Roman, developed with extraordinary ardour the philosophy of his Greek predecessor. He wishes to win over his friend Memmius to the school of Epicurus; and although he has no rewards in a future life to offer, although his object appears to be a purely negative one, he addresses his friend with the heat of an apostle. His object, like that of his great forerunner, is the destruction of superstition; and considering that men trembled before every natural event as a direct monition from the gods, and that everlasting torture was also in prospect, the freedom aimed at by Lucretius might perhaps be deemed a positive good. "This terror," he says, "and darkness of mind must be dispelled, not by the rays of the sun and glittering shafts of day, but by the aspect and the law of nature." He refutes the notion that anything can come out of nothing, or that that which is once begotten can be recalled to nothing. The first beginnings, the atoms, are indestructible, and into them all things can be dissolved at last. Bodies are partly atoms and partly combinations of atoms; but the atoms nothing can quench. They are strong in solid singleness, and by their denser combination all things can be closely packed and exhibit enduring strength. He denies that matter is infinitely divisible. We come at length to the atoms, without which, as an imperishable substratum, all order in the generation and development of things would be destroyed

The mechanical shock of the atoms being in his view the all-sufficient cause of things, he combats the notion that the constitution of nature has been in any way determined by intelligent design. The interaction of the atoms throughout infinite time rendered all manner of combinations possible. Of these the fit ones persisted, while the unfit ones disappeared. Not after sage deliberation did the atoms station themselves in their right places, nor did they bargain what motions they should assume. From all eternity they have been driven together, and after trying motions and unions of every kind, they fell at length into the arrangements out of which this system of things has been formed. His grand conception of the atoms falling silently through immeasurable ranges of space and time suggested the nebular hypothesis to Kant, its first propounder. "If you will apprehend and keep in mind these things, Nature, free at once, and rid of her haughty lords, is seen to do all things spontaneously of herself, without the meddling of the gods." †

During the centuries between the first of these three philosophers and the last, the human intellect was active in other fields than theirs. The Sophists had run through their career. At Athens had appeared the three men, Socrates, Plato, and Aristotle, whose yoke remains to some extent unbroken to the present hour. Within this period also the School of Alexandria was founded, Euclid wrote his "Elements," and he and others made some advance in optics. Archimedes had propounded the theory of the lever and the principles of hydrostatics. Pythagoras had made his experiments on the harmonic intervals, while astronomy was immensely enriched by the discoveries of Hipparchus, who was followed by the historically more celebrated Ptolemy. Anatomy had been made the basis of scientific medicine; and it is said by Draper ‡ that vivisection then began. In fact, the science of ancient Greece had already cleared the world of the fantastic images of divinities operating capriciously through natural phenomena. It had shaken itself free from that fruitless scrutiny "by the internal light of the mind alone," which had vainly sought to transcend experience and reach a knowledge of ultimate causes. Instead of accidental observation, it had introduced observation with a purpose; instruments were employed to aid the senses; and scientific method was rendered in a great measure complete by the union of induction and experiment.

What, then, stopped its victorious advance? Why was the scientific intellect compelled, like an exhausted soil, to lie fallow for nearly two millenniums before it could regather the elements necessary to its fertility and strength? Bacon has already let us know one cause; Whewell ascribes this stationary period to four causes—obscurity of thought, servility, intolerance of disposition, enthusiasm of temper; and he gives striking examples of each.* But these characteristics must have had their causes, which lay in the circumstances of the time. Rome and the other cities of the empire had fallen into moral putrefaction. Christianity had appeared, offering the gospel to the poor, and by moderation if not asceticism of life, practically protesting against the profligacy of the age. The sufferings of the early Christians and the extraordinary exaltation of mind which enabled them to triumph over the diabolical tortures to which they were subjected,† must have left traces not easily effaced. They scorned the earth, in view of that "building of God, that house not made with hands, eternal in the heavens." The Scriptures which ministered to their spiritual needs were also the measure of their science. When, for example, the celebrated question of antipodes came to be discussed, the Bible was with many the ultimate court of appeal. Augustine, who flourished A.D. 400, would not deny the rotundity of the earth, but he would deny the possible existence of inhabitants at the other side, "because no such race is recorded in Scripture among the descendants of Adam." Archbishop Boniface was shocked at the assumption of a "world of human beings out of the reach of the means of salvation" Thus reined in, science was not likely to make much progress. Later on, the political and theological strife between the Church and civil governments, so powerfully depicted by Draper, must have done much to stifle investigation.

Whewell makes many wise and brave remarks regarding the spirit of the Middle Ages. It was a menial spirit. The seekers after natural knowledge had forsaken that fountain of living waters, the direct appeal to nature by observation and experiment, and had given themselves up to the remanipulation of the notions of their predecessors. It was a time when thought had become abject, and when the acceptance of mere authority led, as it always does in science, to intellectual death. Natural events, instead of being traced to physical, were referred to moral causes, while an exercise of the phantasy, almost as degrading as the spiritualism of the present day, took the place of scientific speculation. Then came the mysticism of the Middle Ages, magic, alchemy, the Neo-platonic philosophy, with its visionary though sublime attractions, which caused men to look with shame upon their own bodies as hindrances to the absorption of the creature in the blessedness of the Creator. Finally came the scholastic philosophy, a fusion, according to Lange, of the least mature notions of Aristotle with the Christianity of the west. Intellectual immobility was the result. As a traveller without a compass in a fog may wander long, imagining he is making way, and finds himself, after hours of toil, at his starting-point, so the schoolmen, having tied and untied the same knots, and formed and dissipated the same clouds, found themselves at the end of centuries in their old position

With regard to the influence wielded by Aristotle in the Middle Ages, and which, though to a less extent he still wields, I would ask permission to make one remark. When the human mind has achieved greatness and given evidence of extraordinary power in any domain, there is a tendency to credit it with similar power in all other domains. Thus theologians have found comfort and assurance in the thought that Newton dealt with the question of revelation, forgetful of the fact that the very devotion of his powers, through all the best years of his life, to a totally different class of ideas, not to speak of any natural disqualification, tended to render him less instead of more competent to deal with theological and historic questions. Goethe, starting from his established greatness as a poet, and indeed from his positive discoveries in natural history, produced a profound impression among the painters of Germany when he published his "Farbenlehre," in which he endeavoured to overthrow Newton's theory of colours. This theory he deemed so obviously absurd, that he considered its author a charlatan, and attacked him with a corresponding vehemence of language. In the domain of natural history Goethe had made really considerable discoveries; and we have high authority for assuming that had he devoted himself wholly to that side of science, he might have reached in it an eminence comparable with that which he attained as a poet. In sharpness of observation, in the detection of analogies, however apparently remote, in the classification and organisation of facts according to the analogies discerned, Goethe possessed extraordinary powers. These elements of scientific inquiry fall in with the discipline of the poet. But, on the other hand, a mind thus richly endowed in the direction of natural history, may be almost shorn of endowment as regards the more strictly called physical and mechanical sciences. Goethe was in this condition. He could not formulate distinct mechanical conceptions; he could not see the force of mechanical reasoning; and in regions where such reasoning reigns supreme he became a mere *ignis fatuus* to those who followed him.

---

* Born 99 B.C.

† Monro's translation. In his criticism of this work (*Contemporary Review*, 1867) Dr Hayman does not appear to be aware of the really sound and subtle observations on which the reasoning of Lucretius, though erroneous, sometimes rests

‡ "History of the Intellectual Development of Europe," p 295.

* "History of the Inductive Sciences," vol i.

† Depicted with terrible vividness in Renan's "Antichrist."

I have sometimes permitted myself to compare Aristotle with Goethe, to credit the Stagirite with an almost superhuman power of amassing and systematising facts, but to consider him fatally defective on that side of the mind in respect to which incompleteness has been justly ascribed to Goethe. Whewell refers the errors of Aristotle, not to a neglect of facts, but to "a neglect of the idea appropriate to the facts; the idea of mechanical cause, which is force, and the substitution of vague or inapplicable notions, involving only relations of space or emotions of wonder." This is doubtless true; but the word "neglect" implies mere intellectual misdirection, whereas in Aristotle, as in Goethe, it was not, I believe, misdirection, but sheer natural incapacity which lay at the root of his mistakes. As a physicist, Aristotle displayed what we should consider some of the worst attributes of a modern physical investigator—indistinctness of ideas, confusion of mind, and a confident use of language, which led to the delusive notion that he had really mastered his subject, while he as yet had failed to grasp even the elements of it. He put words in the place of things, subject in the place of object. He preached induction without practising it, inverting the true order of inquiry by passing from the general to the particular, instead of from the particular to the general. He made of the universe a closed sphere, in the centre of which he fixed the earth, proving from general principles, to his own satisfaction and that of the world for near 2,000 years, that no other universe was possible. His notions of motion were entirely unphysical. It was natural or unnatural, better or worse, calm or violent—no real mechanical conception regarding it lying at the bottom of his mind. He affirmed that a vacuum could not exist, and proved that if it did exist motion in it would be impossible. He determined *à priori* how many species of animals must exist, and showed on general principles why animals must have such and such parts. When an eminent contemporary philosopher, who is far removed from errors of this kind, remembers these abuses of the *à priori* method, he will be able to make allowance for the jealousy of physicists as to the acceptance of so-called *à priori* truths. Aristotle's errors of detail were grave and numerous. He affirmed that only in man we had the beating of the heart, that the left side of the body was colder than the right, that men have more teeth than women, and that there is an empty space, not at the front, but at the back of every man's head.

There is one essential quality in physical conceptions which was entirely wanting in those of Aristotle and his followers. I wish it could be expressed by a word untainted by its associations; it signifies a capability of being placed as a coherent picture before the mind. The Germans express the act of picturing by the word *vorstellen*, and the picture they call a *vorstellung*. We have no word in English which comes nearer to our requirements than *imagination*, and, taken with its proper limitations, the word answers very well; but, as just intimated, it is tainted by its associations, and therefore objectionable to some minds. Compare, with reference to this capacity of mental presentation, the case of the Aristotelian, who refers the ascent of water in a pump to Nature's abhorrence of a vacuum, with that of Pascal when he proposed to solve the question of atmospheric pressure by the ascent of the Puy de Dome. In the one case the terms of the explanation refuse to fall into place as a physical image; in the other the image is distinct, the fall and rise of the barometer being clearly figured as the balancing of two varying and opposing pressures.

During the drought of the Middle Ages in Christendom, the Arabian intellect, as forcibly shown by Draper, was active. With the intrusion of the Moors into Spain, cleanliness, order, learning, and refinement took the place of their opposites. When smitten with the disease, the Christian peasant resorted to a shrine; the Moorish one to an instructed physician. The Arabs encouraged translations from the Greek philosophers, but not from the Greek poets. They turned in disgust "from the lewdness of our classical mythology, and denounced as an unpardonable blasphemy all connection between the impure Olympian Jove and the Most High God." Draper traces still further than Whewell the Arab elements in our scientific terms, and points out that the under garment of ladies retains to this hour its Arab name. He gives examples of what Arabian men of science accomplished, dwelling particularly on Alhazen, who was the first to correct the Platonic notion that rays of light are emitted by the eye. He discovered atmospheric refraction, and points out that we see the sun and moon after they have set. He explains the enlargement of the sun and moon, and the shortening of the vertical diameters of both these bodies, when near the horizon. He is aware that the atmosphere decreases in density with increase of height, and actually fixes its height at 58½ miles. In the Book of the Balance Wisdom, he sets forth the connection between the weight of the atmosphere and its increasing density. He shows that a body will weigh differently in a rare and dense atmosphere: he considers the force with which plunged bodies rise through heavier media. He understands the doctrine of the centre of gravity, and applies it to the investigation of balances and steelyards. He recognises gravity as a force, though he falls into the error of making it diminish at the distance, and of making it purely terrestrial. He knows the relation between the velocities, spaces, and times of falling bodies, and has distinct ideas of capillary attraction. He improves the hydrometer. The determination of the densities of the bodies as given by Alhazen approach very closely to our own. "I join," says Draper, in the pious prayer of Alhazen, "that in the day of judgment the All-Merciful will take pity on the soul of Abur-Raihân, because he was the first of the race of men to construct a table of specific gravities." If all this be historic truth (and I have entire confidence in Dr. Draper), well may he "deplore the systematic manner in which the literature of Europe has contrived to put out of sight our scientific obligations to the Mahommedans." *

Towards the close of the stationary period a word-weariness, if I may so express it, took more and more possession of men's minds. Christendom had become sick of the school philosophy and its verbal wastes, which led to no issue, but left the intellect in everlasting haze. Here and there was heard the voice of one impatiently crying in the wilderness, "Not unto Aristotle, not unto subtle hypotheses, not unto Church, Bible, or blind tradition, must we turn for a knowledge of the universe, but to the direct investigation of nature by observation and experiment." In 1543 the epoch-making work of Copernicus on the paths of the heavenly bodies appeared. The total crash of Aristotle's closed universe with the earth as its centre followed as a consequence; "and the earth moves" became a kind of watchword among intellectual freemen. Copernicus was the Canon of the Church of Frauenberg, in the diocese of Ermeland. For three-and-thirty years he had withdrawn himself from the world and devoted himself to the consolidation of his great scheme of the solar system. He made its blocks eternal; and even to those who feared it and desired its overthrow it was so obviously strong that they refrained from meddling with it. In the last year of the life of Copernicus his book appeared: it is said that the old man received a copy of it a few days before his death, and then departed in peace.

The Italian philosopher Giordano Bruno was one of the earliest converts to the new astronomy. Taking Lucretius as his exemplar, he revived the notion of the infinity of worlds; and combining with it the doctrine of Copernicus, reached the sublime generalisation that the stars are fixed suns, scattered numberless through space and accompanied by satellites, which bear the same relation to them as the earth does to our sun, or our moon to our earth. This was an expansion of transcendent import; but Bruno came closer than this to our present line of thought. Struck with the problem of the generation and maintenance of organisms, and duly pondering it, he came to the conclusion that nature in her productions does not imitate the *technic* of man. Her process is one of unravelling and unfolding. The infinity of forms under which matter appears were not imposed upon it by an external artificer; by its own intrinsic force and virtue it brings these forms forth. Matter is not the mere naked, empty *capacity* which philosophers have pictured her to be, but, the universal mother, who brings forth all things as the fruit of her own womb.

---

* "Intellectual Development of Europe," p 359

This outspoken man was originally a Dominican monk. He was accused of heresy and had to fly, seeking refuge in Geneva, Paris, England, and Germany. In 1592 he fell into the hands of the Inquisition at Venice. He was imprisoned for many years, tried, degraded, excommunicated, and handed over to the civil power, with the request that he should be treated gently and "without the shedding of blood." This meant that he was to be burnt; and burnt accordingly he was, on Feb. 16, 1600. To escape a similar fate, Galileo, thirty-three years afterwards, abjured, upon his knees and with his hand on the holy gospels, the heliocentric doctrine. After Galileo came Kepler, who from his German home defied the power beyond the Alps. He traced out from pre-existing observations the laws of planetary motion. The problem was thus prepared for Newton, who bound those empirical laws together by the principle of gravitation.

During the Middle Ages the doctrine of atoms had to all appearance vanished from discussion. In all probability it held its ground among sober-minded and thoughtful men, though neither the Church nor the world was prepared to hear of it with tolerance. Once, in the year 1348, it received distinct expression. But retractation by compulsion immediately followed, and thus discouraged, it slumbered till the seventeenth century, when it was revived by a contemporary of Hobbes and Descartes, the Père Gassendi.

The analytic and synthetic tendencies of the human mind exhibit themselves throughout history, great writers ranging themselves sometimes on the one side, sometimes on the other. Men of lofty feelings, and minds open to the elevating impressions produced by nature as a whole, whose satisfaction, therefore, is rather ethical than logical, have leaned to the synthetic side; while the analytic harmonises best with the more precise and more mechanical bias which seeks the satisfaction of the understanding. Some form of pantheism was usually adopted by the one, while a detached Creator, working more or less after the manner of men, was often assumed by the other.* Gassendi is hardly to be ranked with either. Having formerly acknowledged God as the first great cause, he immediately drops the idea, applies the known laws of mechanics to the atoms, and thence deduces all vital phenomena. God who created earth and water, plants and animals, produced in the first place a definite number of atoms, which constituted the seed of all things. Then began that series of combinations and decompositions which goes on at the present day, and which will continue in the future. The principle of every change resides in matter. In artificial productions the moving principle is different from the material worked upon; but in nature the agent works within, being the most active and mobile part of the material itself. Thus this bold ecclesiastic, without incurring the censure of the Church or the world, contrives to outstrip Mr. Darwin. The same cast of mind which caused him to detach the Creator from his universe led him also to detach the soul from the body, though to the body he ascribes an influence so large as to render the soul almost unnecessary. The aberrations of reason were in his view an affair of the material brain. Mental disease is brain-disease; but then the immortal reason sits apart, and cannot be touched by the disease. The errors of madness are errors of the instrument, not of the performer.

It may be more than a mere result of education, connecting itself probably with the deeper mental structure of the two men, that the idea of Gassendi, above enunciated, is substantially the same as that expressed by Prof. Clerk Maxwell at the close of the very noble lecture delivered by him at Bradford last year. According to both philosophers, the atoms, if I understand aright, are the *prepared materials*, the "manufactured articles," which, formed by the skill of the Highest, produce by their subsequent interaction all the phenomena of the material world. There seems to be this difference, however, between Gassendi and Maxwell. The one *postulates*, the other *infers* his first cause. In his manufactured articles, Prof. Maxwell finds the basis of an induction which enables him to scale philosophic heights considered inaccessible by Kant, and to take the logical step from the atoms to their Maker.

The atomic doctrine, in whole or in part, was entertained by Bacon, Descartes, Hobbes, Locke, Newton, Boyle, and their successors, until the chemical law of multiple proportions enabled Dalton to confer upon it an entirely new significance. In our day there are secessions from the theory, but it still stands firm. Only a year or two ago Sir William Thomson, with characteristic penetration, sought to determine the sizes of the atoms, or rather to fix the limits between which their sizes lie; while only last year the discourses of Williamson and Maxwell illustrate the present hold of the doctrine upon the foremost scientific minds. What these atoms, self-moved and self-posited, can and cannot accomplish in relation to life, is at the present moment the subject of profound scientific thought. I doubt the legitimacy of Maxwell's logic; but it is impossible not to feel the ethic glow with which his lecture concludes. There is, moreover, a Lucretian grandeur in his description of the stedfastness of the atoms:—"Natural causes, as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules out of which these systems are built, the foundation stones of the material universe, remain unbroken and unworn."

Ninety years subsequent to Gassendi the doctrine of bodily instruments, as it may be called, assumed immense importance in the hands of Bishop Butler, who, in his famous "Analogy of Religion," developed, from his own point of view, and with consummate sagacity, a similar idea. The bishop still influences superior minds; and it will repay us to dwell for a moment on his views. He draws the sharpest distinction between our real selves and our bodily instruments. He does not, as far as I remember, use the word soul, possibly because the term was so hackneyed in his day, as it had been for many generations previously. But he speaks of "living powers," "perceiving," or "percipient powers," "moving agents," "ourselves," in the same sense as we should employ the term soul. He dwells upon the fact that limbs may be removed and mortal diseases assail the body, while the mind, almost up to the moment of death, remains clear. He refers to sleep and to swoon, where the "living powers" are suspended but not destroyed. He considers it quite as easy to conceive of an existence out of our bodies as in them; that we may animate a succession of bodies, the dissolution of all of them having no more tendency to dissolve our real selves, or "deprive us of living faculties—the faculties of perception and action—than the dissolution of any foreign matter which we are capable of receiving impressions from, or making use of, for the common occasions of life." This is the key of the bishop's position: "Our organised bodies are no more a part of ourselves than any other matter around us." In proof of this he calls attention to the use of glasses, which "prepare objects" for the "percipient power" exactly as the eye does. The eye itself is no more percipient than the glass, and is quite as much the instrument of the true self, and also as foreign to the true self, as the glass is. "And if we see with our eyes only in the same manner as we do with glasses, the like may justly be concluded from analogy of all our senses."

Lucretius, as you are aware, reached a precisely opposite conclusion; and it certainly would be interesting, if not profitable, to us all, to hear what he would or could urge in opposition to the reasoning of the bishop. As a brief discussion of the point will enable us to see the bearings of an important question, I will here permit a disciple of Lucretius to try the strength of the bishop's position, and then allow the bishop to retaliate, with the view of rolling back, if he can, the difficulty upon Lucretius. Each shall state his case fully and frankly; and you shall be umpire between them. The argument might proceed in this fashion:—

"Subjected to the test of mental presentation (*Vorstellung*) your views, most honoured prelate, would present to many minds a great, if not an insuperable difficulty. You speak of 'living powers,' 'percipient or perceiving powers,' and 'ourselves;' but can you form a mental picture of any one of these apart from the organism through which it is supposed to act? Test yourself honestly, and see whether you possess any faculty that would enable you to form such a conception. The true self has a local habitation in each of us; thus localised, must it not possess a form? If so, what form? Have you ever for a moment realised it? When a leg is amputated the body is divided into two parts; is the true self in both of them or in one? Thomas Aquinas might say in both; but not you, for you appeal to the consciousness associated with one of the two parts to prove that the other is foreign matter. Is consciousness, then, a necessary element of the true self? If so, what do you say to the case of the whole body being deprived of consciousness? If not, then on what grounds do you deny any portion of the true self to the severed limb? It seems very singular that from the beginning to the end of your admirable book (and no one admires its sober strength more than I do), you never once mention the brain or nervous system. You begin at one end of the body, and show that its parts may be removed without prejudice to the perceiving power. What if you begin at the other end, and remove, instead of the leg, the brain? The body, as before, is divided into two parts; but both are now in the same predicament, and neither can be appealed to to prove that the other is foreign matter. Or, instead of going so far as to remove the brain itself, let a certain portion of its bony covering be removed, and let a rhythmic series of pressure and relaxations of pressure be applied to the soft substance. At every pressure 'the faculties of perception and of action' vanish; at every relaxation of pressure they are restored. Where, during the intervals of pressure, is the perceiving power? I once had the discharge of a Leyden battery passed unexpectedly through me: I felt nothing, but was simply blotted out of conscious existence for a sensible interval. Where was my true self during that interval? Men who have recovered from lightning-stroke have been much longer in the same state; and indeed in cases of ordinary concussion of the brain, days may elapse during which no experience is registered in consciousness. Where is the man himself during the period of insensibility? You may say that I beg the question when I assume the man to have been unconscious, that he was really conscious all the time, and has simply forgotten what had occurred to him. In reply to this, I can only say that no one need shrink from the worst tortures that superstition ever invented if only so felt and so remembered. I do not think your theory of instruments goes at all to the bottom of the matter. A telegraph operator has his instruments, by means of which he converses with the world; our bodies possess a nervous system, which plays a similar part between the perceiving powers and external things. Cut the wires of the operator, break his battery, demagnetise his needle: by this means you certainly sever his connection with the world; but inasmuch as these are real instruments, their destruction does not touch the man who uses them. The operator survives, *and he knows that he survives*. What is it, I would ask, in the human system that answers to this conscious survival of the operator when the battery of the brain is so disturbed as to produce insensibility, or when it is destroyed altogether?

---

* Boyle's model of the universe was the Strasburg clock with an outside artificer. Goethe, on the other hand, sang

> "Ihm ziemt's die Welt im Innern zu bewegen,
> Natur in sich, sich in Natur zu hegen."

The same repugnance to the clockmaker conception is manifest in Carlyle.

"Another consideration, which you may consider slight, presses upon me with some force. The brain may change from health to disease, and through such a change the most exemplary man may be converted into a debauchee or a murderer. My very noble and approved good master had, as you know, threatenings of lewdness introduced into his brain by his jealous wife's philter; and sooner than permit himself to run even the risk of yielding to these base promptings he slew himself. How could the hand of Lucretius have been thus turned against himself if the real Lucretius remained as before? Can the brain or can it not act in this distempered way without the intervention of the immortal reason? If it can, then it is a prime mover which requires only healthy regulation to render it reasonably self-acting, and there is no apparent need of your immortal reason at all. If it cannot, then the immortal reason, by its mischievous activity in operating upon a broken instrument, must have the credit of committing every imaginable extravagance and crime. I think, if you will allow me to say so, that the gravest consequences are likely to flow from your estimate of the body. To regard the brain as you would a staff or an eyeglass—to shut your eyes to all its mystery, to the perfect correlation that reigns between its condition and our consciousness, to the fact that a slight excess or defect of blood in it produces that very swoon to which you refer, and that in relation to it our meat and drink and air and exercise have a perfectly transcendental value and significance—to forget all this, does, I think, open a way to innumerable errors in our habits of life, and may possibly in some cases initiate and foster that very disease, and consequent mental ruin, which a wiser appreciation of this mysterious organ would have avoided."

I can imagine the bishop thoughtful after hearing this argument. He was not the man to allow anger to mingle with the consideration of a point of this kind. After due consideration, and having strengthened himself by that honest contemplation of the facts which was habitual with him, and which includes the desire to give even adverse facts their due weight, I can suppose the bishop to proceed thus:—"You will remember that in the 'Analogy of Religion,' of which you have so kindly spoken, I did not profess to prove anything absolutely, and that I over and over again acknowledged and insisted on the smallness of our knowledge, or rather the depth of our ignorance, as regards the whole system of the universe. My object was to show my deistical friends who set forth so eloquently the beauty and beneficence of Nature and the Ruler thereof, while they had nothing but scorn for the so-called absurdities of the Christian scheme, that they were in no better condition than we were, and that for every difficulty they found upon our side, quite as great a difficulty was to be found on theirs. I will now with your permission adopt a similar line of argument. You are a Lucretian, and from the combination and separation of atoms deduce all terrestrial things, including organic forms and their phenomena. Let me tell you in the first instance how far I am prepared to go with you. I admit that you can build crystalline forms out of this play of molcular force; that the diamond, amethyst, and snow-star are truly wonderful structures which are thus produced. I will go further and acknowledge that even a tree or flower might in this way be organised. Nay, if you can show me an animal without sensation, I will concede to you that it also might be put together by the suitable play of molecular force.

"Thus far our way is clear, but now comes my difficulty. Your atoms are individually without sensation, much more are they without intelligence. May I ask you, then, to try your hand upon this problem. Take your dead hydrogen atoms, your dead oxygen atoms, your dead carbon atoms, your dead nitrogen atoms, your dead phosphorus atoms, and all the other atoms, dead as grains of shot, of which the brain is formed. Imagine them separate and sensationless; observe them running together and forming all imaginable combinations. This, as a purely mechanical process, is *seeable* by the mind. But can you see, or dream, or in any way imagine, how out of that mechanical act, and from these individually dead atoms, sensation, thought, and emotion are to arise? You speak of the difficulty of mental presentation in my case; is it less in yours? I am not all bereft of this *Vorstellungs-kraft* of which you speak. I can follow a particle of musk until it reaches the olfactory nerve, I can follow the waves of sound until their tremors reach the water of the labyrinth, and set the otoliths and Corti's fibres in motion; I can also visualise the waves of ether as they cross the eye and hit the retina. Nay, more, I am able to follow up to the central organ the motion thus imparted at the periphery, and to see in idea the very molecules of the brain thrown into tremors. My insight is not baffled by these physical processes. What baffles me, what I find unimaginable, transcending every faculty I possess—transcending, I humbly submit, every faculty *you* possess—is the notion that out of those physical tremors you can extract things so utterly incongruous with them as sensation, thought, and emotion. You may say, or think, that this issue of consciousness from the clash of atoms is not more incongruous than the flash of light from the union of oxygen and hydrogen. But I beg to say that it is. For such incongruity as the flash possesses is that which I now force upon your attention. The flash is an affair of consciousness, the objective counterpart of which is a vibration. It is a flash only by our interpretation. *You* are the cause of the apparent incongruity; and *you* are the thing that puzzles me. I need not remind you that the great Leibnitz felt the difficulty which I feel, and that to get rid of this monstrous deduction of life from death he displaced your atoms by his monads, which were more or less perfect mirrors of the universe, and out of the summation and integration of which he supposed all the phenomena of life—sentient, intellectual, and emotional—to arise.

"Your difficulty, then, as I see you are ready to admit, is quite as great as mine. You cannot satisfy the human understanding in its demand for logical continuity between molecular processes and the phenomena of consciousness. This is a rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life. What is the moral, my Lucretian? You and I are not likely to indulge in ill-temper in the discussion of these great topics, where we see so much room for honest differences of opinion. But there are people of less wit, or more bigotry (I say it with humility) on both sides who are ever ready to mingle anger and vituperation with such discussions. There are, for example, writers of note and influence at the present day who are not ashamed to assume the 'deep personal sin' of a great logician to be the cause of his unbelief in a theologic dogma. And there are others who hold that we, who cherish our noble Bible, wrought as it has been into the constitution of our forefathers, and by inheritance into us, must necessarily be hypocritical and insincere. Let us disavow and discountenance such people, cherishing the unswerving faith that what is good and true in both our arguments will be preserved for the benefit of humanity, while all that is bad or false will disappear."

It is worth remarking that in one respect the bishop was a product of his age. Long previous to his day the nature of the soul had been so favourite and general a topic of discussion, that when the students of the University of Paris wished to know the leanings of a new professor, they at once requested him to lecture upon the soul. About the time of Bishop Butler the question was not only agitated but extended. It was seen by the clear-witted men who entered this arena that many of their best arguments applied equally to brutes and men. The bishop's arguments were of this character. He saw it, admitted it, accepted the consequences, and boldly embraced the whole animal world in his scheme of immortality.

Bishop Butler accepted with unwavering trust the chronology of the Old Testament, describing it as "confirmed by the natural and civil history of the world, collected from common historians, from the state of the earth, and from the late inventions of arts and sciences." These words mark progress: they must seem somewhat hoary to the bishop's successors of to-day.* It is hardly necessary to inform you that since his time the domain of the naturalist has been immensely extended—the whole science of geology, with its astounding revelations regarding the life of the ancient earth, having been created. The rigidity of old conceptions has been relaxed, the public mind being rendered gradually tolerant of the idea that not for six thousand, nor for sixty thousand, nor for six thousand thousand, but for æons embracing untold millions of years, this earth has been the theatre of life and death. The riddle of the rocks has been read by the geologist and palæontologist, from sub-cambrian depths to the deposits thickening over the sea-bottoms of to-day. And upon the leaves of that stone book are, as you know, stamped the characters, plainer and surer than those formed by the ink of history, which carry the mind back into abysses of past time compared with which the periods which satisfied Bishop Butler cease to have a visual angle. Everybody now knows this; all men admit it; still, when they were first broached these verities of science found loud-tongued denunciators, who proclaimed not only their baselessness considered scientifically, but their immorality considered as questions of ethics and religion: the Book of Genesis had stated the question in a different fashion; and science must necessarily go to pieces when it clashed with this authority. And as the seed of the thistle produces a thistle, and nothing else, so these objectors scatter their germs abroad, and reproduce their kind, ready to play again the part of their intellectual progenitors, to show the same virulence, the same ignorance, to achieve for a time the same success, and finally to suffer the same inexorable defeat. Sure the time must come at last when human nature in its entirety, whose legitimate demands it is admitted science alone cannot satisfy, will find interpreters and expositors of a different stamp from those rash and ill-informed persons who have been hitherto so ready to hurl themselves against every new scientific revelation, lest it should endanger what they are pleased to consider theirs.

The lode of discovery once struck, those petrified forms in which life was at one time active, increased to multitudes and demanded classification. The general fact soon became evident that none but the simplest forms of life lie lowest down, that as we climb higher and higher among the superimposed strata more perfect forms appear. The change, however, from form to form was not continuous—but by steps, some small, some great. "A section," says Mr. Huxley, "a hundred feet thick will exhibit at different heights a dozen species of ammonite, none of which passes beyond its particular zone of limestone, or clay, into the zone below it, or into that above it." In the presence of such facts it was not possible to avoid the question, Have these forms, showing, though in broken stages and with many irregularities, this unmistakable general advance, been subjected to no continuous law of growth or variation? Had our education been purely scientific, or had it been sufficiently detached from influences which, however ennobling in another domain, have always proved hindrances and delusions when introduced as factors into the domain of physics, the scientific mind never could have swerved from the search for a law of growth, or allowed itself to accept the anthropomorphism which regarded each successive stratum as a kind of mechanic's bench for the manufacture of new species out of all relation to the old.

Biassed, however, by their previous education, the great majority of naturalists invoked a special creative act to account for the appearance of each new group of organisms. Doubtless there were numbers who were clear-headed enough to see that this was no explanation at all, that in point of fact it was an attempt, by the introduction of a greater difficulty, to account for a less. But having nothing to offer in the way of explanation, they for the most part held their peace. Still the thoughts of reflecting men naturally and necessarily simmered round the question. De Maillet, a contemporary of Newton, has been brought into notice by Prof. Huxley as one who "had a notion of the modifiability of living forms." In my frequent conversations with him, the late Sir Benjamin Brodie, a man of highly philosophic mind, often drew my attention to the fact that, as early as 1794, Charles Darwin's grandfather was the pioneer of Charles Darwin. In 1801, and in subsequent years, the celebrated Lamarck, who produced so profound an impression on the public mind through the vigorous exposition of his views by the author of "Vestiges of Creation," endeavoured to show the development of species out of changes of habit and external condition. In 1813 Dr. Wells, the founder of our present theory of dew, read before the Royal Society a paper in which, to use the words of Mr. Darwin, "he distinctly recognises the principle of natural selection; and this is the first recognition that has been indicated." The thoroughness and skill with which Wells pursued his work, and the obvious independence of his character, rendered him long ago a favourite with me; and it gave me the liveliest pleasure to alight upon this additional testimony to his penetration. Prof. Grant, Mr. Patrick Matthew, Von Buch, the author of the "Vestiges," D'Halloy, and others,* by the enunciation of views more or less clear and correct, showed that the question had been fermenting long prior to the year 1858, when Mr. Darwin and Mr. Wallace simultaneously but independently placed their closely concurrent views upon the subject before the Linnean Society.

These papers were followed in 1859 by the publication of the first edition of "The Origin of Species." All great things come slowly to the birth. Copernicus, as I informed you, pondered his great work for thirty-three years. Newton for nearly twenty years kept the idea of Gravitation before his mind; for twenty years also he dwelt upon his discovery of Fluxions, and doubtless would have continued to make it the object of his private thought had he not found that Leibnitz was upon his track. Darwin for two-and-twenty years pondered the problem of the origin of species, and doubtless he would have continued to do so had he not found Wallace upon his track.† A concentrated but full and powerful epitome of his labours was the consequence. The book was by no means an easy one; and probably not one in every score of those who then attacked it had read its pages through, or were competent to grasp their significance if they had. I do not say this merely to discredit them; for there were in those days some really eminent scientific men, entirely raised above the heat of popular prejudice, willing to accept any conclusion that science had to offer, provided it was duly backed by fact and argument, and who entirely mistook Mr. Darwin's views. In fact the work needed an expounder; and it found one in Mr. Huxley. I know nothing more admirable in the way of scientific exposition than those early articles of his on the origin of species. He swept the curve of discussion through the really significant points of the subject, enriched his exposition with profound original remarks and reflections, often summing up in a single pithy sentence an argument which a less compact mind would have spread over pages. But there is one impression made by the book itself which no exposition of it, however luminous, can convey; and that is the impression of the vast amount of labour, both of observation and of thought, implied in its production. Let us glance at its principles.

It is conceded on all hands that what are called varieties are continually produced. The rule is probably without exception. No chick and no child is in all respects and particulars the counterpart of its brother or sister; and in such differences we have "variety" incipient. No naturalist could tell how far this variation could be carried, but the great mass of them held that never by any amount of internal or external change, nor by the mixture of both, could the offspring of the same progenitor so far deviate from each other as to constitute different species. The function of the experimental philosopher is to combine the conditions of nature and to produce her results; and this was the method of Darwin.* He made himself acquainted with what could, without any manner of doubt, be done in the way of producing variation. He associated himself with pigeon-fanciers—bought, begged, kept, and observed every breed that he could obtain. Though derived from a common stock, the diversities of these pigeons were such that "a score of them might be chosen which, if shown to an ornithologist, and he were told that they were wild birds, would certainly be ranked by him as well-defined species." The simple principle which guides the pigeon-fancier, as it does the cattle-breeder, is the selection of some variety that strikes his fancy, and the propagation of this variety by inheritance. With his eye still upon the particular appearance which he wishes to exaggerate, he selects it as it reappears in successive broods, and thus adds increment to increment until an astonishing amount of divergence from the parent type is effected. Man in this case does not produce the *elements* of the variation. He simply observes them, and by selection adds them together until the required result has been obtained. "No man," says Mr. Darwin, "would ever try to make a fantail till he saw a pigeon with a tail developed in some slight degree in an unusual manner, or a pouter until he saw a pigeon with a crop of unusual size." Thus nature gives the hint, man acts upon it, and by the law of inheritance exaggerates the deviation.

---

* Only to some, for there are dignitaries who even now speak of the earth's rocky crust as so much building material prepared for man at the Creation. Surely it is time that this loose language should cease.

* In 1855 Mr. Herbert Spencer ("Principles of Psychology," 2nd edit. vol. i. p. 465) expressed "the belief that life under all its forms has arisen by an unbroken evolution, and through the instrumentality of what are called natural causes."

† The behaviour of Mr. Wallace in relation to this subject has been dignified in the highest degree.

Having thus satisfied himself by indubitable facts that the organisation of an animal or of a plant (for precisely the same treatment applies to plants) is to some extent plastic, he passes from variation under domestication to variation under nature. Hitherto we have dealt with the adding together of small changes by the conscious selection of man. Can Nature thus select? Mr. Darwin's answer is, "Assuredly she can." The number of living things produced is far in excess of the number that can be supported; hence at some period or other of their lives there must be a struggle for existence; and what is the infallible result? If one organism were a perfect copy of the other in regard to strength, skill, and agility, external conditions would decide. But this is not the case. Here we have the fact of variety offering itself to nature, as in the former instance it offered itself to man; and those varieties which are least competent to cope with surrounding conditions will infallibly give way to those that are competent. To use a familiar proverb, the weakest comes to the wall. But the triumphant fraction again breeds to over-production, transmitting the qualities which secured its maintenance, but transmitting them in different degrees. The struggle for food again supervenes, and those to whom the favourable quality has been transmitted in excess will assuredly triumph. It is easy to see that we have here the addition of increments favourable to the individual still more rigorously carried out than in the case of domestication; for not only are unfavourable specimens not selected by nature, but they are destroyed. This is what Mr. Darwin calls "natural selection," which "acts by the preservation and accumulation of small inherited modifications, each profitable to the preserved being." With this idea he interpenetrates and leavens the vast store of facts that he and others have collected. We cannot, without shutting our eyes through fear or prejudice, fail to see that Darwin is here dealing, not with imaginary, but with true causes; nor can we fail to discern what vast modifications may be produced by natural selection in periods sufficiently long. Each individual increment may resemble what mathematicians call a "differential" (a quantity indefinitely small); but definite and great changes may obviously be produced by the integration of these infinitesimal quantities through practically infinite time.

If Darwin, like Bruno, rejects the notion of creative power acting after human fashion, it certainly is not because he is unacquainted with the numberless exquisite adaptations on which this notion of a supernatural artificer is founded. His book is a repository of the most startling facts of this description. Take the marvellous observation which he cites from Dr. Crüger, where a bucket with an aperture, serving as a spout, is formed in an orchid. Bees visit the flower: in eager search of material for their combs they push each other into the bucket, the drenched ones escaping from their involuntary bath by the spout. Here they rub their backs against the viscid stigma of the flower and obtain glue; then against the pollen-masses, which are thus stuck to the back of the bee and carried away. "When the bee, thus provided, flies to another flower, or to the same flower a second time, and is pushed by its comrades into the bucket, and then crawls out by the passage, the pollen-mass upon its back necessarily comes first into contact with the viscid stigma," which takes up the pollen; and this is how that orchid is fertilised. Or take this other case of the *Catasetum*. "Bees visit these flowers in order to gnaw the labellum; on doing this they inevitably touch a long, tapering, sensitive projection. This, when touched, transmits a sensation or vibration to a certain membrane, which is instantly ruptured, setting free a spring, by which the pollen-mass is shot forth like an arrow in the right direction, and adheres by its viscid extremity to the back of the bee." In this way the fertilising pollen is spread abroad.

It is the mind thus stored with the choicest materials of the teleologist that rejects teleology, seeking to refer these wonders to natural causes. They illustrate, according to him, the method of nature, not the "technic" of a man-like artificer. The beauty of flowers is due to natural selection. Those that distinguish themselves by vividly contrasting colours from the surrounding green leaves are most readily seen, most frequently visited by insects, most often fertilised, and hence most favoured by natural selection. Coloured berries also readily attract the attention of birds and beasts, which feed upon them, spread their manured seeds abroad, thus giving trees and shrubs possessing such berries a greater chance in the struggle for existence.

With profound analytic and synthetic skill, Mr. Darwin investigates the cell-making instinct of the hive-bee. His method of dealing with it is representative. He falls back from the more perfectly to the less perfectly developed instinct—from the hive-bee to the humble-bee, which uses its own cocoon as a comb, and to classes of bees of intermediate skill, endeavouring to show how the passage might be gradually made from the lowest to the highest. The saving of wax is the most important point in the economy of bees. Twelve to fifteen pounds of dry sugar are said to be needed for the secretion of a single pound of wax. The quantities of nectar necessary for the wax must therefore be vast; and every improvement of constructive instinct which results in the saving of wax is a direct profit to the insect's life. The time that would otherwise be devoted to the making of wax is now devoted to the gathering and storing of honey for winter food. He passes from the humble-bee with its rude cells, through the Melipona with its more artistic cells, to the hive-bee with its astonishing architecture. The bees place themselves at equal distances apart upon the wax, sweep and excavate equal spheres round the selected points. The spheres intersect, and the planes of intersection are built up with thin laminæ. Hexagonal cells are thus formed. This mode of treating such questions is, as I have said, representative. He habitually retires from the more perfect and complex, to the less perfect and simple, and carries you with him through stages of *perfecting*, adds increment to increment of infinitesimal change, and in this way gradually breaks down your reluctance to admit that the exquisite climax of the whole could be a result of natural selection.

Mr. Darwin shirks no difficulty; and, saturated as the subject was with his own thought, he must have known, better than his critics, the weakness as well as the strength of his theory. This of course would be of little avail were his object a temporary dialectic victory instead of the establishment of a truth which he means to be everlasting. But he takes no pains to disguise the weakness he has discerned; nay, he takes every pains to bring it into the strongest light. His vast resources enable him to cope with objections started by himself and others, so as to leave the final impression upon the reader's mind that if they be not completely answered they certainly are not fatal. Their negative force being thus destroyed, you are free to be influenced by the vast positive mass of evidence he is able to bring before you. This largeness of knowledge and readiness of resource render Mr. Darwin the most terrible of antagonists. Accomplished naturalists have levelled heavy and sustained criticisms against him—not always with the view of fairly weighing his theory, but with the express intention of exposing its weak points only. This does not irritate him. He treats every objection with a soberness and thoroughness which even Bishop Butler might be proud to imitate, surrounding each fact with its appropriate detail, placing it in its proper relations, and usually giving it a significance which, as long as it was kept isolated, failed to appear. This is done without a trace of ill-temper. He moves over the subject with the passionless strength of a glacier; and the grinding of the rocks is not always without a counterpart in the logical pulverisation of the objector. But though in handling this mighty theme all passion has been stilled, there is an emotion of the intellect incident to the discernment of new truth which often colours and warms the pages of Mr. Darwin. His success has been great; and this implies not only the solidity of his work, but the preparedness of the public mind for such a revelation. On this head a remark of Agassiz impressed me more than anything else. Sprung from a race of theologians, this celebrated man combated to the last the theory of natural selection. One of the many times I had the pleasure of meeting him in the United States was at Mr. Winthrop's beautiful residence at Brookline, near Boston. Rising from luncheon, we all halted as if by a common impulse in front of a window, and continued there a discussion which had been started at table. The maple was in its autumn glory; and the exquisite beauty of the scene outside seemed, in my case, to interpenetrate without disturbance the intellectual action. Earnestly, almost sadly, Agassiz turned and said to the gentlemen standing round, "I confess that I was not prepared to see this theory received as it has been by the best intellects of our time. Its success is greater than I could have thought possible."

---

* The first step only towards experimental demonstration has been taken. Experiments now begun might, a couple of centuries hence, furnish data of incalculable value, which ought to be supplied to the science of the future

In our day great generalisations have been reached. The theory of the origin of species is but one of them. Another, of still wider grasp and more radical significance, is the doctrine of the Conservation of Energy, the ultimate philosophical issues of which are as yet but dimly seen—that doctrine which "binds nature fast in fate" to an extent not hitherto recognised, exacting from every antecedent its equivalent consequent, from every consequent its equivalent antecedent, and bringing vital as well as physical phenomena under the dominion of that law of causal connection which, as far as the human understanding has yet pierced, asserts itself everywhere in nature. Long in advance of all definite experiment upon the subject, the constancy and indestructibility of matter had been affirmed; and all subsequent experience justified the affirmation. Later researches extended the attribute of indestructibility to force. This idea, applied in the first instance to inorganic, rapidly embraced organic nature. The vegetable world, though drawing almost all its nutriment from invisible sources, was proved incompetent to generate anew either matter or force. Its matter is for the most part transmuted air; its force transformed solar force. The animal world was proved to be equally uncreative, all its motive energies being referred to the combustion of its food. The activity of each animal as a whole was proved to be the transferred activities of its molecules. The muscles were shown to be stores of mechanical force, potential until unlocked by the nerves, and then resulting in muscular contractions. The speed at which messages fly to and fro along the nerves was determined, and found to be, not, as had been previously supposed, equal to that of light or electricity, but less than the speed of a flying eagle.

This was the work of the physicist: then came the conquests of the comparative anatomist and physiologist, revealing the structure of every animal, and the function of every organ in the whole biological series, from the lowest zoophyte up to man. The nervous system had been made the object of profound and continued study, the wonderful and, at bottom, entirely mysterious controlling power which it exercises over the whole organism, physical and mental, being recognised more and more. Thought could not be kept back from a subject so profoundly suggestive. Besides the physical life dealt with by Mr. Darwin, there is a psychical life presenting similar gradations, and asking equally for a solution. How are the different grades and orders of mind to be accounted for? What is the principle of growth of that mysterious power which on our planet culminates in Reason? These are questions which, though not thrusting themselves so forcibly upon the attention of the general public, had not only occupied many reflecting minds, but had been formally broached by one of them before the "Origin of Species" appeared.

With the mass of materials furnished by the physicist and physiologist in his hands, Mr. Herbert Spencer, twenty years ago, sought to graft upon this basis a system of psychology; and two years ago a second and greatly amplified edition of his work appeared. Those who have occupied themselves with the beautiful experiments of Plateau, will remember that when two spherules of olive-oil suspended in a mixture of alcohol and water of the same density as the oil, are brought together, they do not immediately unite. Something like a pellicle appears to be formed around the drops, the rupture of which is immediately followed by the coalescence of the globules into one. There are organisms whose vital actions are almost as purely physical as that of these drops of oil. They come into contact and fuse themselves thus together. From such organisms to others a shade higher, and from these to others a shade higher still, and on through an ever-ascending series, Mr. Spencer conducts his argument. There are two obvious factors to be here taken into account—the creature and the medium in which it lives, or, as it is often expressed, the organism and its environment. Mr. Spencer's fundamental principle is, that between these two factors there is incessant interaction. The organism is played upon by the environment, and is modified to meet the requirements of the environment. Life he defines to be a "continuous adjustment of internal relations to external relations."

In the lowest organisms we have a kind of tactual sense diffused over the entire body; then, through impressions from without and their corresponding adjustment, special portions of the surface become more responsive to stimuli than others. The senses are nascent, the basis of all of them being that simple tactual sense which the sage Democritus recognised 2,300 years ago as their common progenitor. The action of light, in the first instance, appears to be a mere disturbance of the chemical processes in the animal organism, similar to that which occurs in the leaves of plants. By degrees the action becomes localised in a few pigment-cells, more sensitive to light than the surrounding tissue. The eye is here incipient. At first it is merely capable of revealing differences of light and shade produced by bodies close at hand. Followed as the interception of the light is in almost all cases by the contact of the closely adjacent opaque body, sight in this condition becomes a kind of "anticipatory touch." The adjustment continues; a slight bulging out of the epidermis over the pigment-granules supervenes. A lens is incipient, and, through the operation of infinite adjustments, at length reaches the perfection that it displays in the hawk and the eagle. So of the other senses; they are special differentiations of a tissue which was originally vaguely sensitive all over.

With the development of the senses the adjustments between the organism and its environment gradually extend in *space*, a multiplication of experiences and a corresponding modification of conduct being the result. The adjustments also extend in *time*, covering continually greater intervals. Along with this extension in space and time, the adjustments also increase in speciality and complexity, passing through the various grades of brute life and prolonging themselves into the domain of reason. Very striking are Mr. Spencer's remarks regarding the influence of the sense of touch upon the development of intelligence. This is, so to say, the mother-tongue of all the senses, into which they must be translated to be of service to the organism. Hence its importance. The parrot is the most intelligent of birds, and its tactual power is also greatest. From this sense it gets knowledge unattainable by birds which cannot employ their feet as hands. The elephant is the most sagacious of quadrupeds—its tactual range and skill, and the consequent multiplication of experiences, which it owes to its wonderfully adaptable trunk, being the basis of its sagacity. Feline animals, for a similar cause, are more sagacious than hoofed animals—atonement being to some extent made, in the case of the horse, by the possession of sensitive prehensile lips. In the *Primates* the evolution of intellect and the evolution of tactual appendages go hand in hand. In the most intelligent anthropoid apes, we find the tactual range and delicacy greatly augmented, new avenues of knowledge being thus opened to the animal. Man crowns the edifice here, not only in virtue of his own manipulatory power, but through the enormous extension of his range of experience, by the invention of instruments of precision, which serve as supplemental senses and supplemental limbs. The reciprocal action of these is finely described and illustrated. That chastened intellectual emotion to which I have referred in connection with Mr. Darwin is, I should say, not absent in Mr. Spencer. His illustrations possess at times exceeding vividness and force, and from his style on such occasions it is to be inferred that the ganglia of this apostle of the understanding are sometimes the seat of a nascent poetic thrill.

It is a fact of supreme importance that actions, the performance of which at first requires even painful effort and deliberation, may by habit be rendered automatic. Witness the slow learning of its letters by a child, and the subsequent facility of reading in a man when each group of letters which forms a word is instantly and without effort fused to a single perception. Instance the billiard-player, whose muscles of hand and eye, when he reaches the perfection of his art, are unconsciously co-ordinated. Instance the musician, who by practice is enabled to fuse a multitude of arrangements, auditory, tactual, and muscular, into a process of automatic manipulation. Combining such facts with the doctrine of hereditary transmission, we reach a theory of instinct. A chick, after coming out of the egg, balances itself correctly, runs about, picks up food, thus showing that it possesses a power of directing its movements to definite ends. How did the chick learn this very complex co-ordination of eye, muscles, and beak? It has not been individually taught; its personal experience is *nil*; but it has the benefit of ancestral experience. In its inherited organisation are registered all the powers which it displays at birth. So also as regards the instinct of the hive-bee, already referred to. The distance at which the insects stand apart when they sweep their hemispheres and build their cells is "organically remembered." Man also carries with him the physical texture of his ancestry, as well as the inherited intellect bound up with it. The defects of intelligence during infancy and youth are probably less due to a lack of individual experience than to the fact that in early life the cerebral organisation is still incomplete. The period necessary for completion varies with the race and with the individual. As a round shot outstrips a rifled one on quitting the muzzle of the gun, so the lower race in childhood may outstrip the higher. But the higher eventually overtakes the lower, and surpasses it in range. As regards individuals, we do not always find the precocity of youth prolonged to mental power in maturity, while the dulness of boyhood is sometimes strikingly contrasted with the intellectual energy of after years. Newton, when a boy, was weakly, and he showed no particular aptitude at school; but in his eighteenth year he went to Cambridge, and soon afterwards astonished his teachers by his power of dealing with geometrical problems. During his quiet youth his brain was slowly preparing itself to be the organ of those energies which he subsequently displayed.

By myriad blows (to use a Lucretian phrase) the image and superscription of the external world are stamped as states of consciousness upon the organism, the depth of the impression depending upon the number of the blows. When two or more phenomena occur in the environment invariably together, they are stamped to the same depth or to the same relief, and are indissolubly connected. And here we come to the threshold of a great question. Seeing that he could in no way rid himself of the consciousness of space and time, Kant assumed them to be necessary "forms of thought," the moulds and shapes into which our intuitions are thrown, belonging to ourselves solely and without objective existence. With unexpected power and success Mr. Spencer brings the hereditary experience theory, as he holds it, to bear upon this question. "If there exist certain external relations which are experienced by all organisms at all instants of their waking lives—relations which are absolutely constant and universal—there will be established answering internal relations that are absolutely constant and universal. Such relations we have in those of space and time. As the substratum of all other relations of the Non-Ego, they must be responded to by conceptions that are the substrata of all other relations in the Ego. Being the constant and infinitely repeated elements of thought, they must become the automatic elements of thought—the elements of thought which it is impossible to get rid of—the 'forms of intuition.'"

Throughout this application and extension of the "law of inseparable association," Mr. Spencer stands on totally different ground from Mr. John Stuart Mill, invoking the registered experiences of the race instead of the experiences of the individual. His overthrow of Mr. Mill's restriction of experience is, I think, complete. That restriction ignores the power of organising experience furnished at the outset to each individual; it ignores the different degrees of this power possessed by different races and by different individuals of the same race. Were there not in the human brain a potency antecedent to all experience, a dog or cat ought to be as capable of education as a man. These predetermined internal relations are independent of the experiences of the individual. The human brain is the "organised register of infinitely numerous experiences received during the evolution of life, or rather during the evolution of that series of organisms through which the human organism has been reached. The effects of the most uniform and frequent of these experiences have been successively bequeathed, principal and interest, and have slowly mounted to that high intelligence which lies latent in the brain of the infant. Thus it happens that the European inherits from twenty to thirty cubic inches more of brain than the Papuan. Thus it happens that faculties, as of music, which scarcely exist in some inferior races, become congenital in superior ones. Thus it happens that out of savages unable to count up to the number of their fingers, and speaking a language containing only nouns and verbs, arise at length our Newtons and Shakespeares."

At the outset of this address it was stated that physical theories which lie beyond experience are derived by a process of abstraction from experience. It is instructive to note from this point of view the successive introduction of new conceptions. The idea of the attraction of gravitation was preceded by the observation of the attraction of iron by a magnet, and of light bodies by rubbed amber. The polarity of magnetism and electricity appealed to the senses; and thus became the substratum of the conception that atoms and molecules are endowed with definite, attractive, and repellent poles, by the play of which definite forms of crystalline architecture are produced. Thus molecular force becomes *structural*. It required no great boldness of thought to extend its play into organic nature, and to recognise in molecular force the agency by which both plants and animals are built up. In this way out of experience arise conceptions which are wholly ultra-experiential.

The *origination* of life is a point lightly touched upon, if at all, by Mr. Darwin and Mr. Spencer. Diminishing gradually the number of progenitors, Mr. Darwin comes at length to one "primordial form;" but he does not say, as far as I remember, how he supposes this form to have been introduced. He quotes with satisfaction the words of a celebrated author and divine who had "gradually learnt to see that it is just as noble a conception of the Deity to believe He created a few original forms, capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws." What Mr. Darwin thinks of this view of the introduction of life I do not know. Whether he does or does not introduce his "primordial form" by a creative act, I do not know. But the question will inevitably be asked, "How came the form there?" With regard to the diminution of the number of created forms, one does not see that much advantage is gained by it. The anthropomorphism, which it seemed the object of Mr. Darwin to set aside, is as firmly associated with the creation of a few forms as with the creation of a multitude. We need clearness and thoroughness here. Two courses, and two only, are possible. Either let us open our doors freely to the conception of creative acts, or, abandoning them, let us radically change our notions of matter. If we look at matter as pictured by Democritus, and as defined for generations in our scientific text-books, the absolute impossibility of any form of life coming out of it would be sufficient to render any other hypothesis preferable; but the definitions of matter given in our text-books were intended to cover its purely physical and mechanical properties. And taught as we have been to regard these definitions as complete, we naturally and rightly reject the monstrous notion that out of *such* matter any form of life could possibly arise. But are the definitions complete? Everything depends on the answer to be given to this question. Trace the line of life backwards, and see it approaching more and more to what we call the purely physical condition. We reach at length those organisms which I have compared to drops of oil suspended in a mixture of alcohol and water. We reach the *protogenes* of Haeckel, in which we have "a type distinguishable from a fragment of albumen only by its finely granular character." Can we pause here? We break a magnet and find two poles in each of its fragments. We continue the process of breaking, but however small the parts, each carries with it, though enfeebled, the polarity of the whole. And when we can break no longer, we prolong the intellectual vision to the polar molecules. Are we not urged to do *something* similar in the case of life? Is there not a temptation to close to some extent with Lucretius, when he affirms that "Nature is seen to do all things spontaneously of herself without the meddling of the gods?" or with Bruno, when he declares that matter is not "that mere empty *capacity* which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb?" The questions here raised are inevitable. They are approaching us with accelerated speed, and it is not a matter of indifference whether they are introduced with reverence or irreverence. Abandoning all disguise, the confession that I feel bound to make before you is that I prolong the vision backward across the boundary of the experimental evidence, and discern in that matter, which we in our ignorance, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of every form and quality of life.

The "materialism" here enunciated may be different from what you suppose, and I therefore crave your gracious patience to the end. "The question of an external world," says Mr. J. S. Mill, "is the great battle-ground of metaphysics."[*] Mr. Mill himself reduces external phenomena to "possibilities of sensation." Kant, as we have seen, made time and space "forms" of our own intuitions. Fichte, having first by the inexorable logic of his understanding proved himself to be a mere link in that chain of eternal causation which holds so rigidly in nature, violently broke the chain by making nature, and all that it inherits, an apparition of his own mind.[†] And it is by no means easy to combat such notions. For when I say I see you, and that I have not the least doubt about it, the reply is, that what I am really conscious of is an affection of my own retina. And if I urge that I can check my sight of you by touching you, the retort would be that I am equally transgressing the limits of fact; for what I am really conscious of is, not that you are there, but that the nerves of my hand have undergone a change. All we hear, and see, and touch, and taste, and smell, are, it would be urged, mere variations of our own condition, beyond which, even to the extent of a hair's breadth, we cannot go. That anything answering to our impressions exists outside of ourselves is not a *fact*, but an *inference*, to which all validity would be denied by an idealist like Berkeley, or by a sceptic like Hume. Mr. Spencer takes another line. With him, as with the uneducated man, there is no doubt or question as to the existence of an external world. But he differs from the uneducated, who think that the world really *is* what consciousness represents it to be. Our states of consciousness are mere *symbols* of an outside entity which produces them and determines the order of their succession, but the real nature of which we can never know.[‡] In fact the whole process of evolution is the manifestation of a Power absolutely inscrutable to the intellect of man. As little in our day as in the days of Job can man by searching find this Power out. Considered fundamentally, it is by the operation of an insoluble mystery that life is evolved, species differentiated, and mind unfolded from their prepotent elements in the immeasurable past. There is, you will observe, no very rank materialism here.

The strength of the doctrine of evolution consists, not in an experimental demonstration (for the subject is hardly accessible to this mode of proof), but in its general harmony with the method of nature as hitherto known. From contrast, moreover, it derives enormous relative strength. On the one side we have a theory (if it could with any propriety be so called) derived, as were the theories referred to at the beginning of this address, not from the study of nature, but from the observation of men—a theory which converts the Power whose garment is seen in the visible universe into an Artificer, fashioned after the human model, and acting by broken efforts, as man is seen to act. On the other side we have the conception that all we see around us, and all we feel within us—the phenomena of physical nature as well as those of the human mind—have their unsearchable roots in a cosmical life, if I dare apply the term, an infinitesimal span of which only is offered to the investigation of man. And even this span is only knowable in part. We can trace the development of a nervous system, and correlate with it the parallel phenomena of sensation and thought. We see with undoubting certainty that they go hand in hand. But we try to soar in a vacuum the moment we seek to comprehend the connection between them. An Archimedean fulcrum is here required which the human mind cannot command; and the effort to solve the problem, to borrow an illustration from an illustrious friend of mine, is like the effort of a man trying to lift himself by his own waistband. All that has been here said is to be taken in connection with this fundamental truth. When "nascent senses" are spoken of, when "the differentiation of a tissue at first vaguely sensitive all over" is spoken of, and when these processes are associated with "the modification of an organism by its environment," the same parallelism, without contact, or even approach to contact, is implied. There is no fusion possible between the two classes of facts—no motor energy in the intellect of man to carry it without logical rupture from the one to the other.

Further, the doctrine of evolution derives man, in his totality, from the interaction of organism and environment through countless ages past. The human understanding, for example—the faculty which Mr. Spencer has turned so skilfully round upon its own antecedents—is itself a result of the play between organism and environment through cosmic ranges of time. Never surely did prescription plead so irresistible a claim. But then it comes to pass that, over and above his understanding, there are many other things appertaining to man whose prescriptive rights are quite as strong as that of the understanding itself. It is a result, for example, of the play of organism and environment that sugar is sweet and that aloes are bitter, that the smell of henbane differs from the perfume of a rose. Such facts of consciousness (for which, by the way, no adequate reason has ever yet been rendered) are quite as old as the understanding itself; and many other things can boast an equally ancient origin. Mr. Spencer at one place refers to that most powerful of passions—the amatory passion—as one which, when it first occurs, is antecedent to all relative experience whatever; and we may pass its claim as being at least as ancient and as valid as that of the understanding itself. Then there are such things woven into the texture of man as the feeling of awe, reverence, wonder—and not alone the sexual love just referred to, but the love of the beautiful, physical and moral, in nature, poetry, and art. There is also that deep-set feeling which, since the earliest dawn of history, and probably for ages prior to all history, incorporated itself in the religions of the world. You who have escaped from these religions in the high-and-dry light of the understanding may deride them; but in so doing you deride accidents of form merely, and fail to touch the immovable basis of the religious sentiment in the emotional nature of man. To yield this sentiment reasonable satisfaction is the problem of problems at the present hour. And grotesque in relation to scientific culture as many of the religions of the world have been and are—dangerous, nay, destructive, to the dearest privileges of freemen as some of them undoubtedly have been, and would, if they could, be again—it will be wise to recognise them as the forms of force, mischievous, if permitted to intrude on the region of *knowledge*, over which it holds no command, but capable of being guided by liberal thought to noble issues in the region of *emotion*, which is its proper sphere. It is vain to oppose this force with a view to its extirpation. What we should oppose, to the death if necessary, is every attempt to found upon this elemental bias of man's nature a system which should exercise despotic sway over his intellect. I do not fear any such consummation. Science has already to some extent leavened the world, and it will leaven it more and more. I should look upon the mild light of science breaking in upon the minds of the youth of Ireland, and strengthening gradually to the perfect day, as a surer check to any intellectual or spiritual tyranny which might threaten this island, than the laws of princes or the swords of emperors. Where is the cause of fear? We fought and won our battle even in the Middle Ages: why should we doubt the issue of a conflict now?

The impregnable position of science may be described in a few words. All religious theories, schemes, and systems, which embrace notions of cosmogony, or which otherwise reach into its domain, must, in so far as they do this, submit to the control of science, and relinquish all thought of controlling it. Acting otherwise proved disastrous in the past, and it is simply fatuous to-day. Every system which would escape the fate of an organism too rigid to adjust itself to its environment, must be plastic to the extent that the growth of knowledge demands. When this truth has been thoroughly taken in, rigidity will be relaxed, exclusiveness diminished, things now deemed essential will be dropped, and elements now rejected will be assimilated. The lifting of the life is the essential point; and as long as dogmatism, fanaticism, and intolerance are kept out, various modes of leverage may be employed to raise life to a higher level. Science itself not unfrequently derives motive power from an ultra-scientific source. Whewell speaks of enthusiasm of temper as a hindrance to science; but he means the enthusiasm of weak heads. There is a strong and resolute enthusiasm in which science finds an ally; and it is to the lowering of this fire, rather than to a diminution of intellectual insight, that the lessening productiveness of men of science in their mature years is to be ascribed. Mr. Buckle sought to detach intellectual achievement from moral force. He gravely erred; for without moral force to whip it into action, the achievement of the intellect would be poor indeed.

---

[*] "Examination of Hamilton," p. 154.

[†] "Bestimmung des Menschen."

[‡] In a paper, at once popular and profound, entitled "Recent Progress in the Theory of Vision," contained in the volume of lectures by Helmholtz, published by Longmans, this symbolism of our states of consciousness is also dwelt upon. The impressions of sense are the mere *signs* of external things. In this paper Helmholtz contends strongly against the view that the consciousness of space is inborn, and he evidently doubts the power of the chick to pick up grains of corn without some preliminary lessons. On this point he says, further experiments are needed. Such experiments have been since made by Mr. Spalding, aided, I believe, in some of his observations by the accomplished and deeply lamented Lady Amberley, and they seem to prove conclusively that the chick does not need a single moment's tuition to teach it to stand, run, govern the muscles of its eyes, and peck. Helmholtz, however, is contending against the notion of pre-established harmony, and I am not aware of his views as to the organisation of experiences of race or breed.

It has been said that science divorces itself from literature. The statement, like so many others, arises from lack of knowledge. A glance at the less technical writings of its leaders—of its Helmholtz, its Huxley, and its Du Bois-Reymond—would show what breadth of literary culture they command. Where among modern writers can you find their superiors in clearness and vigour of literary style? Science desires no isolation, but freely combines with every effort towards the bettering of man's estate. Single-handed, and supported not by outward sympathy, but by inward force, it has built at least one great wing of the many-mansioned home which man in his totality demands. And if rough walls and protruding rafter-ends indicate that on one side the edifice is still incomplete, it is only by wise combination of the parts required with those already irrevocably built that we can hope for completeness. There is no necessary incongruity between what has been accomplished and what remains to be done. The moral glow of Socrates, which we all feel by ignition, has in it nothing incompatible with the physics of Anaxagoras which he so much scorned, but which he would hardly scorn to-day. And here I am reminded of one amongst us, hoary, but still strong, whose prophet-voice some thirty years ago, far more than any other of this age, unlocked whatever of life and nobleness lay latent in its most gifted minds—one fit to stand beside Socrates or the Maccabean Eleazar, and to dare and suffer all that they suffered and dared—fit, as he once said of Fichte, "to have been the teacher of the Stoa, and to have discoursed of beauty and virtue in the groves of Academe." With a capacity to grasp physical principles which his friend Goethe did not possess, and which even total lack of exercise has not been able to reduce to atrophy, it is the world's loss that he, in the vigour of his years, did not open his mind and sympathies to science, and make its conclusions a portion of his message to mankind. Marvellously endowed as he was—equally equipped on the side of the heart and of the understanding—he might have done much towards teaching us how to reconcile the claims of both, and to enable them in coming times to dwell together in unity of spirit and in the bond of peace.

And now the end is come. With more time, or greater strength and knowledge, what has been here said might have been better said, while worthy matters here omitted might have received fit expression. But there would have been no material deviation from the views set forth. As regards myself, they are not the growth of a day; and as regards you, I thought you ought to know the environment which, with or without your consent, is rapidly surrounding you, and in relation to which some adjustment on your part may be necessary. A hint of Hamlet's, however, teaches us all how the troubles of common life may be ended; and it is perfectly possible for you and me to purchase intellectual peace at the price of intellectual death. The world is not without refuges of this description; nor is it wanting in persons who seek their shelter and try to persuade others to do the same. I would exhort you to refuse such shelter, and to scorn such base repose—to accept, if the choice be forced upon you, commotion before stagnation, the leap of the torrent before the stillness of the swamp. In the one there is at all events life, and therefore hope; in the other, none. I have touched on debatable questions, and led you over dangerous ground—and this partly with the view of telling you, and through you the world, that as regards these questions science claims unrestricted right of search. It is not to the point to say that the views of Lucretius and Bruno, of Darwin and Spencer, may be wrong. Here I should agree with you, deeming it indeed certain that these views will undergo modification. But the point is, that, whether right or wrong, we claim the freedom to discuss them. The ground which they cover is scientific ground; and the right claimed is one made good through tribulation and anguish, inflicted and endured in darker times than ours, but resulting in the immortal victories which science has won for the human race. I would set forth equally the inexorable advance of man's understanding in the path of knowledge, and the unquenchable claims of his emotional nature which the understanding can never satisfy. The world embraces not only a Newton, but a Shakespeare—not only a Boyle, but a Raphael—not only a Kant, but a Beethoven—not only a Darwin, but a Carlyle. Not in each of these, but in all, is human nature whole. They are not opposed, but supplementary—not mutually exclusive, but reconcilable. And if, still unsatisfied, the human mind, with the yearning of a pilgrim for his distant home, will turn to the mystery from which it has emerged, seeking so to fashion it as to give unity to thought and faith, so long as this is done, not only without intolerance or bigotry of any kind, but with the enlightened recognition that ultimate fixity of conception is here unattainable, and that each succeeding age must be held free to fashion the mystery in accordance with its own needs—then, in opposition to all the restrictions of Materialism, I would affirm this to be a field for the noblest exercise of what, in contrast with the *knowing* faculties, may be called the *creative* faculties of man. Here, however, I must quit a theme too great for me to handle, but which will be handled by the loftiest minds ages after you and I, like streaks of morning cloud, shall have melted into the infinite azure of the past.

SECTION A

Mathematical and Physical

Opening Address by the President, the Rev. Prof. J. H. Jellett, M.A., M.R.I.A.

In opening the business of the Section, my first duty is, as you will naturally anticipate, to return my warmest thanks to the British Association for the honour which they have conferred upon me by inviting me to occupy this chair. I do it, I assure you, with all sincerity, fully sensible how high the compliment is; and if I do not dwell further upon the subject, it is, as I hope you will believe, because the president of a Section ought to occupy your time, not by speaking of himself or his own feelings, but by a review, more or less extensive, of those branches of science which form the proper business of the Section.

I say "more or less extensive;" for in determining what kind of review he will present to you, the president of this Section has a very wide range of choice. He may give you a rapid but (in its outline) complete sketch of the progress of mathematical science during the past year. He may select some one special subject, probably (and rightly) the subject with which he is himself especially conversant, giving of that a more detailed account; or he may take a middle course, neither so extensive as the first nor quite so limited as the second. It is this latter course which I wish now to take, proposing to direct your attention, during the short time which I can allow myself, to the relations, becoming every day more fully developed, not only among the branches of science which properly belong to us, but between our Section and the other Sections of the Association, or, in other words, between the sciences which we ordinarily call mathematical or physical and some of the other sciences to which the British Association is devoted. I am the more anxious to direct your attention to this class of subjects, because recent investigation has shown how fertile for discovery the "border land," if I may so call it, between sciences hitherto considered distinct has been found to be. Instances in proof of this will present themselves as we go on; some have no doubt suggested themselves to you already.

We are called, in ordinary language, the Mathematical Section. The adjective must indeed be understood in a very wide sense—too wide perhaps for strict propriety of language, if it be meant to include every thing to which our labours here are devoted; still the use of the term "mathematical" indicates, and truly indicates, the preponderance which in this Section we give to mathematics and to those sciences which are at present capable of mathematical treatment; and therefore the first question which in the consideration of our present subject naturally presents itself is, Does this list of sciences show any prospect of increase? Are we making, are we likely to make, an increased use of mathematics as an instrument of physical investigation? Are we trying to improve its use in those sciences which are already recognised as belonging to its legitimate province? Are we trying to perfect the mathematical treatment of such sciences as optics or electricity, which have been already brought under the sway of mathematics? Are we trying to extend its sway by bringing under it sciences (chemistry, for example, or biology) in which as yet its power has been but little felt? Or have we come to the conclusion, to which some writers would lead us, that we have already pushed the use of mathematics too far?

Is it true, for example, and do we feel it to be true, that in our anxiety to bring physical optics completely under the power of mathematical science, we have abandoned the principles of the inductive philosophy, and substituted mere hypotheses for true knowledge? And are we convinced, at least, that every chemist is bound, as he values the truth and reality of his science, to resist the introduction into chemistry of the methods of mathematical analysis, if any such attempt should be made?

This latter is the opinion of Comte, whose severe strictures on the application of mathematical analysis to physical optics I shall have to consider further on; for the present I would confine your attention to the inquiry, What indications on this subject are presented by the actual progress of physical science? Does its history exhibit a tendency to widen or to contract the field of mathematical analysis?

In reviewing, with this purpose, the history of physical science, we may leave out of sight those sciences, or parts of a science, to which the methods and language of mathematics are applicable without the aid of hypotheses. No scientific man doubts the advantage of applying, as far as our analytic powers enable us so to do, the methods of mathematical analysis to such sciences as plain optics or plain astronomy. Even physical astronomy, although in strict logical precision not wholly independent of hypothesis, has been long recognised as, in the most proper sense of the word, a mathematical science. Wherever, in fact, the fundamental equations rest either on direct observation (as in plain optics) or (as in physical astronomy) upon an hypothesis, if we may venture to call it an hypothesis, so entirely accepted as universal gravitation, the extension of the methods of mathematics is only limited by the weakness of mathematical analysis itself. But there are other sciences, as, for example, physical optics, to which mathematical analysis cannot be applied without the intervention of hypotheses more or less uncertain. And if we would appreciate the true character of scientific progress, the question which we must put to scientific history is this, Is science becoming more or less tolerant of such hypotheses? A principle is assumed, possessing in itself a certain amount of plausibility, and capable of mathematical expression, from which we are able to deduce, as consequences and by mathematical reasoning, phenomena whose reality may afterwards be proved by direct experiment. And from this experimental verification we infer, with more or less probability, the truth of the original assumption. The question, then, which we have to put to scientific history is this: Do the records of science indicate a greater or a less tolerance of this kind of logic? Is the mode of physical investigation which I have shortly sketched gaining or losing the favour of scientific men?

Passing over sciences like astronomy, which, though not wholly free from hypothesis, do not give very extended information on this point, I come to a part of scientific history to which we may put the question with every probability of obtaining (so far, at least, as one science is concerned) a decisive answer—I mean the history of physical optics.

We have here a science whose basis is purely hypothetical. The definition of light is an hypothesis, the nature of the ethereal motion is an hypothesis, even the very existence of the ether is an hypothesis—hypotheses, indeed, which have led to conclusions amply verified by experiment, but hypotheses still. Does the history of optical science indicate a desire to discard this hypothetical base? Does the history of this science betray a tendency on the part of scientific men to abandon or neglect mechanical theories of light? Have physicists given up as hopeless, or perhaps unphilosophical, the attempt to reduce, by the intervention of a supposed ether, the phenomena of light under the mathematical laws which govern motion? Are they even abandoning the reasoning or the phraseology of the undulatory system? The answer to these questions is not doubtful. Commencing with Fresnel, more than half a century ago, the history of physical optics is a history of efforts, constantly repeated, to frame what M. de St. Venant has called "a really rational theory of light."

Take, for example, the repeated attempts to reconcile the mechanical principle of continuity with the optical phenomenon of double refraction. When the movement which we call light passes from one medium to another, if the molecular movement be continuous, it is hard to see how the elastic force of the ether can be different at different sides of the plane of separation. It would seem, then, that the principle requires that the elastic force of the ether should be the same in all the media. But if it be the same in a crystalline as in an uncrystalline medium, it ought to be the same in every direction; and if it be the same in every direction, how are we to account for the phenomenon of double refraction? The effort to overcome this difficulty may be said to have engaged the attention of Cauchy during all the latter part of his life. The same question was taken up after his death by other writers, among whom I may mention M. Boussinesq as the most recent, and is to this day a question of great interest to mathematical physicists. I am not now inquiring whether the reasoning which I have just stated be valid, or whether the difficulty, which some writers do not appear to have felt, be real. I allude to it only as a proof of the anxiety felt by men who have borne the greatest names in optical science to have a complete mechanical theory of light. It would be easy to multiply instances, affecting all the great phenomena of optics, which evince the same anxiety.

Another and even stronger proof of the firm footing which the undulatory theory has obtained in the world of science, is the familiarity with which we use the terms of that theory, as if they denoted actual physical realities. When, not long since, much labour was expended in calculating the wave-lengths for the several rays of the spectrum, there does not appear to have been among physicists any consciousness that they were discussing, and even professing to measure, things which had no existence but in the fancy of mathematicians. On the contrary, we have come to speak of wave-lengths quite as freely and as familiarly as we speak of indices of refraction. Nor is this true only of detached memoirs, which might be supposed to represent only individual opinion. The language and the principles of the undulatory theory have found their way into our ordinary text-books—a sure proof that these principles have been generally accepted by the scientific world. I am not now discussing the question whether, regarded as an indication of scientific progress, this fact is favourable or unfavourable. I only say that it *is* a fact. M. Comte has done all that the hard words of a man of great genius could do to banish theories of light from the domain of science, but his greatest admirer will hardly say that he has been successful.

I pass to the consideration of another branch of science, closely connected with, and indeed including, physical optics, and exemplifying, even more strongly, the desire of scientific men to extend the sway of mathematics over physical science—I mean Molecular Mechanics. This branch of mechanical science (if, indeed, it be not more correct to say, this science) is altogether modern. Fifty years ago it had hardly begun to exist, and even now it is in a very imperfect condition. Imperfect as it is, however, it has advanced far enough to mark the progress of science in the direction which I have indicated. And as it is a science more general than physical optics, the indications which we can gather from it are more important. Physical optics does not take us outside our own Section; molecular mechanics shows a marked tendency to carry mathematical analysis into the domain of chemistry. If it shall ever be possible to establish an intimate connection between this latter science and theoretical mechanics, it is probably here that we shall find the connecting link. In truth it is impossible to contemplate the ever-growing tendency of science to see in so many natural phenomena varieties of motion, without anticipating a time when mathematical dynamics (the science which has already reduced so many of the phenomena of motion beneath the power of mathematical analysis) shall be admitted to be the universal interpreter of nature, as completely as it is now admitted to be the interpreter of the motions of the planets. I do not say that it will ever be. I do not even say that it is possible. It is no true philosophy which dogmatises on the future of science. But it is certain that the current of scientific thought is setting strongly in that direction. The constant tendency of scientific thought is, as I have said, to increase the number of those phenomena which are regarded as mere varieties of motion. Sound—that we have placed on the list long since. Light, though here our conclusions are more hypothetical, we have also long regarded as belonging to the same category; and heat may now be fairly added; and we have almost learned, under the guidance of Professor Williamson, to regard chemical combination as a phenomenon of the same kind. All these phenomena (of sound, of light, of heat, and perhaps even of chemical combination) we now regard as produced by the movements of systems of exceedingly small particles—whether of known particles, as in the case of sound, or of the hypothetical ether, as in the case of light; and a science which proposes to itself the mathematical discussion of the laws which govern the movements of such systems can hardly fail to play an important part in the future history of physical science. I shall not then, I hope, be thought to misemploy the time of the Section by offering some observations on the science of molecular dynamics.

When we have to deal with a science which professes to be more than a mathematical abstraction—a science which assumes to itself the function of representing, with at least approximate truth, the realities of nature—our first question will naturally be, What is the basis on which it rests? Is it built upon a pure hypothesis, not derived from experiment, but seeking to justify its claim to reality by the truth of the results which may be deduced from it?

The word "molecule," as Prof. Maxwell has told us, is modern, embodying an idea derived from modern chemistry. It denotes a material particle so small as to be incapable of subdivision into parts similar in their nature to itself. Thus a drop of water may be divided into smaller drops, each of which is also water; but a *molecule* of water is regarded as incapable of such division. Not that we regard it as absolutely indivisible; but we assume that a further division, could it be effected, would produce molecules, not of water, but of its component gases, hydrogen and oxygen.

Now this conception of a molecule undoubtedly involves an hypothesis. Are there such ultimate particles of matter, not only resisting all the dividing forces which we can command, but absolutely indivisible, by *any force*, into particles similar to each other, or perhaps into particles of any kind? Or are we to suppose that, if we had instruments of sufficient delicacy, the process of division might be carried on without limit? Experiment gives us no means of deciding between these alternatives; and if the exigencies of our method of investigation force us to make a decision, we can make it only by an hypothesis. But we may fairly ask, Does the logic of molecular dynamics absolutely require this decision. And on this point I wish to offer one or two remarks. When we propose to determine the motion of a body, solid or fluid, we ought, as indeed in all scientific problems, to form in the first place a clear conception of the meaning of the question which we propose to ourselves. We wish to discover the laws which govern the motion—of what? Not certainly of the body taken as a whole. That is, no doubt, part of the information which we seek, but a very small part of it. When we have learned to determine by a fixed mathematical rule, or formula as we generally call it, the position occupied at any instant by the centre of gravity of the body and by its principal axes, we have learned something, but the investigation is far from being complete. There are, as you know, large classes of movements of which such knowledge would tell us nothing. Thus, to take a familiar instance, you see a man (to use our ordinary language) "sitting quiet." He is at rest, so far as the movement of the body, taken as a whole, is concerned. He is neither turning on his chair, nor walking about the room; and yet there is probably not a single particle of his body which is absolutely quiescent. You see, then, how ignorant we are of the vital movements of the human body, if we know only that the individual is "sitting quiet."

But suppose that we push the inquiry a little further and propose to investigate the motion of the blood. We obtain an answer to this question in one sense by determining the rate at which the blood, taken as a whole, is moving—that is to say, suppose the number of ounces of blood which pass through the mitral valve in the space of one minute; but having learned this, we are still very far from knowing completely the motion of the blood. But suppose that we are able to assign at any instant the position of each one of the blood-globules considered as a unit—that is to say, suppose we could assign for each of these globules the position of its centre of gravity and the positions of its principal axes, we should then know the motion of the blood, not, indeed, perfectly (for we should still be ignorant of the motion of the *serum* as well as of the internal movements which take place in each globule), but very much more completely than before.

Further (and this is the point to which I wish especially to direct your attention), the results would be equally true, whether the globules were really units, incapable of further subdivision, or really aggregates of still smaller particles. In the former case we should know perfectly the motion of that part of the blood which consists of the red globules; in the latter, we should know the same motion, but not perfectly; that is to say, our results, though true as far as they go, would leave us still in ignorance of one or more classes of motions which are really exhibited by the globules of the blood. We should then be obliged to imagine a still further subdivision. If, for example, we divided, in imagination, each globule into a thousand parts, and could determine the motion of each part considered as a unit, our results would still further approximate to completeness; and so on for further subdivisions. The logic of molecular dynamics may then be shortly stated as follows:—

In seeking to form the equations of motion of a body, solid or fluid, we commence by an imaginary division of the body into elements of any arbitrary magnitude, and we form the equations of motion for each of these elements considered as a unit. The results so obtained are true, but, as long as the elements retain a finite magnitude, incomplete. They do not give us full information as to the movement of the system. But suppose now, adopting the spirit of the differential calculus, that the magnitude of these elements is constantly diminished; then it will be found that, as in the differential calculus, these equations tend towards a certain limiting form, constantly approaching it as the magnitude of the elements is continually diminished; and in this limiting form these equations are not only true but complete.

Stated in this general form, the principles of molecular dynamics are not only perfectly logical, but wholly free from hypothesis. Hypotheses have, no doubt, been freely introduced for the purpose of forming the actual equations in any given case; but molecular dynamics, as such, is not an hypothetical science. The word molecular is in some respects unfortunate, as tending to identify the science with a particular hypothesis as to the constitution of matter. But molecular dynamics as a science has no necessary connection with the molecular hypothesis. In truth, the methods of this science harmonise quite as readily with the supposition of the infinite divisibility of matter as with the supposition of ultimate molecules.

Molecular dynamics may fairly be called the differential calculus of physical science. It is, in its relation to physical science, what the differential calculus is in its relation to geometry. As in geometry, when we would pass from the small and exceptional class of rectilinear figures to the infinite varieties of curve-lines, we must invoke the aid of the differential calculus, so when we would pass from the abstractions of rigid solids and unbending surfaces to the contemplation of bodies as they really exist in nature, must we, if we would fully investigate their phenomena, invoke the aid of molecular dynamics. It is the science of that phenomenon which is gradually drawing all others within its sway; it is the science of that phenomenon which, "changed in all, and yet in all the same," we have learned to see in every part of nature. Molecular dynamics is the science of Motion in its widest and truest sense—of the motion which passes along in the sweep of the tempest or the fierce throb of the earthquake—of the motion (no less real) which breathes in the gentlest whisper or thrills along the minutest nerve.

I have dealt thus long upon the subject of molecular dynamics because the amount of attention which in the present century it has commanded, and the great advance which it has made, mark most distinctly the tendency of scientific thought to the introduction of mathematical analysis into all parts of physical science; for molecular dynamics is the key to this introduction. It is to the perfection of this science that we must look for an increased use of the mathematical instrument; and when we combine the indications afforded by the history of this science with those which we may derive from the history of its principal application (Physical Optics), we have at least this partial answer to our question—Mathematical analysis shows no sign of relaxing its grasp upon any of the sciences which have been hitherto considered to belong to its domain; nay, more, the desire to extend that domain is indicated by the efforts to perfect the instrument by which that extension must be made. We may now ask, Is this indication confirmed by the history of any of those sciences which have been hitherto regarded as lying wholly without our Section?

And first, what shall we say of Section B? Does chemical science show any indications pointing to a future union with the group already collected under the *genus* (if I may so call it) Theoretical Mechanics? Take, for example, the great problem of chemical combination. Does the treatment of this problem now show any signs pointing in the direction of dynamical science? I desire here to speak with all reserve and even hesitation, being conscious that I am no longer on familiar ground. Still there are signs which even an outside spectator may read. And we may, I think, speak confidently of their direction, although the goal to which they point is far distant and may perhaps be unattainable.

One of these signs is the appearance of *time* as one of the elements of a chemical problem. And in recognising the necessity of a certain time for the production of a chemical effect, chemists are now pointing not obscurely to the analogy of mechanical science. "Time," says Berthelot, "is necessary for the accomplishment of chemical reactions, as it is for all the other mechanical phenomena." This might not in itself be very significant; but chemists have not merely recognised the necessity of time as a condition for the production of chemical phenomena, they have also undertaken to measure it; or rather, taking the converse problem, they have undertaken to measure the amount of chemical effect produced in the unit of time; and the law of this phenomenon announced by Berthelot takes (necessarily, indeed) a mathematical form quite analogous to equations which present themselves in dynamical science. The next step has followed as a matter of course, and chemists now speak as familiarly of the *velocity* of chemical reagents as engineers do of the velocity of a cannon-ball.

Still more important in its bearing on the future of chemistry, and tending distinctly in the same direction, is the theory of chemical combination, which science owes to Prof. Williamson, and according to which this phenomenon, like so many others, ought to be regarded as in great measure a mode of motion We suppose the normal condition of the atomic constituents of a body to be *motion*, not rest; and when we say that a molecule of one substance enters into *combination* with a molecule of another substance, we do not mean that the same molecules constantly adhere together, but that the union between the molecules, whatever be its nature, is continually dissolved and as continually re-formed. According to this theory, chemical equilibrium does not denote molecular rest, but a system of molecular motion, in which these decompositions and recompositions balance each other.

If I may venture to add anything to that which comes from such an authority, I would say that this theory leads us naturally to regard the chemical properties of bodies as, if not wholly modes of motion, yet largely dependent upon the nature of the movements which take place among their constituent atoms. Hence, if two bodies incapable of chemical action are brought into chemical presence of each other, we may suppose that their atomic movements, and therefore their properties, remain unaltered. If, on the other hand, these bodies be capable of acting chemically on each other, their atomic movements are modified by their mutual chemical presence; and therefore the chemical properties of the compound, as we call it, may be wholly different from those of either of the bodies which have entered into combination.

Now we are not yet prepared to consider chemical combination as a problem of molecular dynamics. We have not sufficiently clear ideas (even hypothetical ideas) of these atomic movements, and of the modifications which are caused by the chemical presence of another body, to place the investigation of these phenomena in the same category with the investigation of the phenomena of physical optics; and I am sure that any attempt to hasten unduly the affiliation of chemistry to theoretical dynamics would be productive of serious mischief. The drift of the remarks which I have made has been only to show that the current of scientific thought is setting in that direction; and while we may not predict such an affiliation, still less should we be justified in pronouncing it to be beyond the possibilities or even the probabilities of science.

Time will only allow me to notice very briefly another important application of mathematics to a branch of science considered hitherto to be altogether beyond the limits of our Section,—I refer to the application of the methods of geometry and theoretical mechanics to biological science recently made by Prof. Haughton.

The first example which I shall notice is the establishment of a principle governing the animal frame, and quite analogous to the principle of "least action" in dynamics. This principle asserts that every muscle is so framed as to perform the greatest amount of work under the given external circumstances. If this principle be admitted as an *à priori* truth, the arrangement of any given muscle may be mathematically deduced from it; but many, no doubt, will prefer to regard it as an inductive truth established by the number of instances which Professor Haughton has adduced and discussed. Among these the work done by the human heart is considered; and in order more fully to exemplify the principle of the economy of work, Professor Haughton has imagined a very obvious construction of the heart in which the principle would be violated, contrasting this with the actual construction in which, as he has shown, the principle is preserved.

Prof. Haughton has also made much use of the geometry of curved surfaces in estimating the action of the non-plane muscles.

On the whole the work of Prof. Haughton is a remarkable example of the increasing use of mathematical methods in the investigation of physical problems.

We have put to scientific history the important question, Is it probable that the dominion of mathematics over physical science will be more widely extended than it is at present? Is it probable, not only that we shall improve the mathematical instrument as applied to those sciences which are already recognised as belonging to the legitimate province of mathematical analysis, but also that we shall learn to apply the same instrument to sciences which are now wholly or partially independent of its authority? And to this question I think that scientific history must answer, Yes, it *is* probable. It is probable, because physical science is learning more and more every day to see in the phenomena of nature modifications of that one phenomenon which is peculiarly under the power of mathematics. It is probable, because science already indicates the path by which that advance will be made, because we already possess in molecular dynamics a method (the creation, I may almost say, of our own age, and still very imperfect) whose proper subject is motion, not in any limited or abstract sense, but as widely as it really exists in nature. And it is probable, because we cannot look back on the history of science for the last fifty years without becoming conscious how large is the advance which has been already made.

I have thus far endeavoured to show to you the light which is thrown on the connection between physical science and mathematical analysis by actual scientific history; and I have given you some reasons for believing, so far as it is permitted to us to read the future, that this connection is likely to extend still more widely.

But before we pass from this part of the subject, we are bound to ask the question, Are we to regard this indication as being favourable to the cause of scientific progress? Shall we regard the tendency to use, as far as possible, the mathematical instrument in physical investigation as being likely to extend our real knowledge of nature? Or will its result be merely to encourage the formation of vain hypotheses, recommended only by their capability of mathematical expression, and deeply injuring the cause of science by means of the facility with which men accept such speculations as real knowledge? This latter opinion seems to be, on the whole, that of Comte, whose severe strictures upon physical theories of light I have noticed before.

Now, I believe that the advocate of the mathematical method of investigation might be, and would be, perfectly content to fight the battle of mathematical physics on the ground which Comte himself has chosen. We have put one important question to the history of science, let us put another.

Has the effect of theories of light upon the progress of real optical knowledge (knowledge which Comte himself would admit to be real) been beneficial or injurious?

This question belongs to a class to which the answer is never easy. It is never an easy task to abstract one from a group of causes which concur in the production of an effect, and then determine how the effect would have been changed by such removal. Still we may succeed in obtaining at least a partial answer to the question.

It has been frequently remarked as one of the benefits conferred upon physical science by theory, that it suggests experiment. Nowhere is this principle more strongly exemplified than in the history of perhaps the greatest name in optical science—I mean Fresnel. He is an experimentalist, certainly; but he is an experimentalist because he is a theorist. His most valuable experiments had their origin in the desire to test the truth of a theory. The experiment with the two mirrors was devised to test Young's principle of interference. His diffraction experiments were devised at first to test the truth of Young's theory; and when that had been found to be inconsistent with fact, then to test the truth of his own. And, not to multiply instances, the experiments by which he established the existence of circular polarisation, and ascertained the true nature of the light which passes along the axis of a quartz crystal, were suggested by theory.

Among the motives which induced Jamin to undertake the experimental researches which have given to science such valuable results, not the least was the desire to test the truth of an hypothetical principle of Fresnel and of a theoretic formula of Cauchy. And quite recently M. Abria has made an elaborate examination of uniaxial refraction for the purpose of testing the truth of the construction of Huyghens. I may here remark that it is much to be desired that some competent observer would undertake the yet more difficult task of verifying experimentally the wave-surface of Fresnel.

But to revert to the general subject. If any physicist is inclined to agree with the views of Comte upon this subject, let me propose to him the following test:—Let him strike out of physical optics everything which that science owes to theories of light, and then let him try to write a treatise on the subject, excluding the language and the ideas of theory. Finally, let him compare his work with some treatise in which these aids have not been neglected, and judge himself of their relative value. Theoretic science need not be afraid of the result.

Naturally suggested by the subject which we have been considering, namely, the tendency of scientific progress to a reduction of all physical science under the power of mathematical analysis, is the gradual development of connections between the different members of that great group to which we give the name of physical science. And among the instances of such growing relationship I take, also suggested by the topics which have engaged us, the connection between optics and chemistry. I only say "suggested" by our former subject, for I do not desire to attach any undue significance to the fact that of these connected sciences one may already be called a mathematical science. As yet the connection between these sciences has consisted principally in the introduction into chemistry of an analysis in some respects more refined than any which has been hitherto known. And this fact does not in itself indicate the extension to chemistry of the mathematical character which belongs to physical optics. Still, if we hold the assumption of this character by any science to be the mark of perfection, we shall be inclined to regard every improvement in its instruments of research as tending in that direction.

In speaking of the connection between optics and chemistry, the topic which will occur first to everyone is the Spectroscope; but on this part of the subject it is not necessary that I should dwell. It has so largely occupied the attention of physicists, and has been so fully treated by those who have made it their special study, that I could not hope to add any thing to what they have said. I would only observe that the spectroscope has enabled chemistry to overleap a barrier which Comte pronounced to be insurmountable, and which would have excluded from the objects of chemical research anything lying without the limits of our earth. Comte warned us that our knowledge of the planetary worlds was necessarily limited to their geometrical and mechanical properties—to the nature of their movements, and the forces by which they are produced—and that all inquiry into the constituent elements of the planets or their atmospheres was for ever, and by the necessities of the case, interdicted to us. But the spectroscope has told quite another story.

But there is another point of contact between optics and chemistry,—another spot on the border-land between these two sciences, which, I think, promises also to be fertile in discovery,—I mean the use of polarised light as an instrument of chemical analysis. It is true that the application of this instrument is limited in its extent. The physical property on which this application depends (namely, the power possessed by certain liquids to change the plane of polarisation of a transmitted ray, or, as it is commonly called, the rotatory power) is altogether confined to the organic world, and is not universal even there. Still, within this limited range, the application of polarised light is capable of solving, or aiding to solve, chemical problems which chemistry proper would probably find very difficult. Let me give you two examples.

1. Is it true that an acid salt is decomposed by solution? Or, taking the question in another form: If to a solution of a neutral salt there be added, atom for atom, a quantity of its own acid, does that additional atom of acid enter into combination, or does it remain free? It has been usually inferred from the thermic researches of Dr. Andrews, followed up by Favre, Silbermann, Berthelot, and others, that the second alternative is the true one, the solvent being water. Now, if the problem be varied a little by making the solvent spirit, the application of polarised light gives us this important information:—

If to an alcoholic solution of the ordinary nitrate of quinia there be added an additional equivalent of acid, this additional equivalent *does* enter into combination with the nitrate.

This information leaves to us the alternative of supposing that the ordinary nitrate, sulphate, &c., of quinia are not neutral but basic salts, or of admitting that an acid salt is not always decomposed by solution, at least in spirit.

2. When an acid is added to a solution containing two bases, the salts formed being also soluble, does the acid divide itself between the bases? and if so, what is the law which governs the division?

The application of polarised light enables us to solve this question for some of the organic bases, proving that there is a continuous partition of the acid, and enabling us in one case, and probably in many others, to assign the law according to which the partition is made.

One more instance may suffice to exemplify the advantage which chemistry proper has already derived from its union with optics. I take this instance from the general problem of saccharometry.

We have long known how to analyse, both optically and chemically, a solution which contains two kinds of sugar, one of which is sucrose? But as each of these methods gives but two equations, it is plain that neither is sufficient where the unknown quantities are more than two. If, then, as is very commonly the case, there are present in the solution three kinds of sugar, we cannot obtain a complete analysis, either from optics or from chemistry. But, as Dr. Apjohn has recently shown, this problem, insoluble by either method taken alone, is readily solved by a combination of both methods. An important step is thus made in the application of optics to chemistry. Instead of merely giving to chemistry a new solution of a problem which chemistry could solve without any assistance, optics has aided chemistry to solve a problem which chemistry unaided might have found very difficult.

But it is time that I should bring these remarks to a close, and I recur, in conclusion, to a thought which my subject has already suggested.

Let none presume to fix the bounds of Science. "Hitherto shalt thou come, but no further"—that sentence is not for man. Not by our own powers, not by the powers of our generation, not even by the conceptions of possibility, may we limit the march of scientific discovery. To us, labourers in that great field, it is given to see but a few steps in advance. And when at times a thicker darkness has seemed to gather before them, men have recoiled as from an impassable barrier, and for a while that path has been closed. But only for a while. Some happy accident, some more daring adventurer, it may be time itself, has shown that the darkness was but a cloud. The light of Science has pierced it; the march of Science has left it behind; and the impossibility of one generation is for the next but the record of a new triumph.

If seeming plausibility could give to man the right to draw across any path of scientific discovery an impassable line, surely Comte might be justified in the line which he drew across the path of chemistry. Fifty years ago it might seem no unjust restriction to say to the chemist, Your field of discovery lies within the bounds of our own earth. You must not hope to place in your laboratory the distant planet or the scarce-visible nebula. You must not hope to determine the constituents of their atmospheres as you would analyse the air which is around your own door; and you will never do it. Fifty years ago no chemist would have complained that chemical discovery was unjustly limited by such a sentence; perhaps no chemist would have refused to join in the prediction. Yet even those who heard it uttered have lived to see the prediction falsified. They have seen the barrier of distance vanish before the chemist, as it has long since vanished before the astronomer. They have seen the chemist, like the astronomer, penetrate the vast abyss of space and bring back tidings from the worlds beyond. Comte might well think it impossible. We know it to be true.

We have learned from this episode of scientific history that the attempt to draw an impassable line between the domain of the chemist and the domain of the astronomer was not justified by the result. Another generation may learn to obliterate as completely the line between the domain of the chemist and the domain of the mathematician. When that shall be, when Science shall have subjected all natural phenomena to the laws of Theoretical Mechanics, when she shall be able to predict the result of every combination as unerringly as Hamilton predicted conical refraction or Adams revealed to us the existence of Neptune—that we cannot say. That day may never come, and it is certainly far in the dim future. We may not anticipate it:—

we may not even call it possible. But not the less are we bound to look to that day, and to labour for it as a crowning triumph of Science, when Theoretical Mechanics shall be recognised as the key to every physical enigma—the chart for every traveller through the dark infinite of Nature.

SECTION C

GEOLOGY

OPENING ADDRESS OF THE PRESIDENT, PROF. EDWARD HULL, F.R.S.

On the Volcanic Phenomena of County Antrim and adjoining Districts.

FOLLOWING the example of several Presidents of the Geological Section of the British Association, I purpose commencing our proceedings by an address, selecting for my subject the volcanic phenomena of the district in which we are assembled. But before entering upon this subject, I am sure it will be equally in accordance with your feelings and my own if I give expression to the general and deep regret which is felt at the death (so little expected) of the late President of this Section, Prof. John Phillips, of Oxford, on April 24, in the 74th year of his age.

The late Prof. Phillips.—As the nephew and pupil of Mr. William Smith, "the Father of English Geology," Prof. Phillips was nurtured in an atmosphere of geological science which accorded well with his own tastes; and in his youth was the companion and assistant of his uncle in many a surveying-tour in the east and north of England. His subsequent appointment as Keeper of the Museum at York, and one of the secretaries of the Yorkshire Philosophical Society, gave him opportunities and scope for pursuing his inquiries—ultimately resulting in the publication of his laborious work on "The Geology of Yorkshire," a work not only abounding in local details, but containing the germs of several generalisations on questions relating to physical geology.

Of his connection with the Geological Survey of Great Britain, Prof. Phillips has left two enduring monuments in his work on "The Palæozoic Fossils of Cornwall, Devon, and West Somerset," and that on "The Malvern Hills and surrounding districts"*—one dealing with the organic structures, and the other more especially with the physical conditions of the south and west of England.

To his future career as Professor of Geology in the University of Dublin, afterwards, on the death of Dr. Buckland, in the University of Oxford, or as President of the Geological Society of London in 1859 and of the British Association at Birmingham in 1865, it is unnecessary for me in this brief notice to do more than allude. Through these years and down to the time of his decease his fertile brain and ready pen were ever at work. But the scope of his investigations was not limited to purely geological subjects; he was a man of many parts, and astronomical questions largely engaged his attention in his later years. In 1868 he visited Italy and Vesuvius, and subsequently published a little work on the history and structure of that mountain in a form very acceptable to that large portion of the travelling British public which at one time or another makes the delightful pilgrimage to the workshop of Vulcan and the Phlegræan Fields.

The loss of Prof. Phillips' presence at the meetings of the British Association, of which he was one of the founders, is irreparable. His genial face and lucid words brought sunshine wherever he appeared, and threw light on every topic he handled; to him might well be applied the words—"quidquid tetigit ornavit." While lamenting his loss, let us endeavour to imitate the example of his untiring industry, his patient pursuit of the beautiful and noble in nature, his honesty of character, his purity of life.†

The Volcanic District of the North-east of Ireland.—I have now to direct your attention to the district of County Antrim and its neighbourhood as one claiming our special investigation, and presenting a multitude of interesting problems connected with the volcanic phenomena of the Tertiary period. By the labours of Berger, Weaver, Portlock, Griffith, Bryce, Tate, Holden, and other geologists, many of these problems have received a solution; others remain for further discussion. It shall be my endeavour to give you a brief summary of the facts and inferences arrived at up to this time, and to present you with a connected history of the operations carried on by terrestrial agents in this island, from the commencement of the volcanic era to its close.

This era, though short as compared with the sum of geologic time, was in reality vastly extended, and comprised within its limits several stages or divisions characterised by special physical conditions. Speaking in geological terms, it probably included the latter part of the Eocene and the whole of the Miocene periods, interrupted by long pauses in the outburst of volcanic products.

But before entering upon the narrative of events which occupied this space of time, let us first endeavour to determine the physical limits of the theatre of these operations; for it may well be asked, considering the great extent to which the volcanic products have been cleared from off the surface of the country by denudation, with what degree of precision can we define the original limits of the volcanic area?

Let us for a moment, when replying to this question, turn to a still more recent volcanic district for an illustration. When we ascend the cone of Vesuvius, and from that commanding station sweep with our eyes the surrounding region, we find ourselves in the centre of a plain—the Campagna of Naples—formed of the products of volcanic eruptions, but limited through three quarters of a circle by calcareous hills of older date, and along the other portion by the sea.

I believe that similarly, but on a far more extended scale, we can trace out the original limits of the volcanic district of the north-east of Ireland, and that from some elevated stations rising from the central plateau of Antrim these limits may be almost descried by the uprising of ridges of more ancient rocks in several directions. Taking our stand on Tardree Hill, or Slemish, we see to the southward the gigantic and schistose ridge of Slieve Croob, projected against a background of the mountains of Mourne, culminating in Slieve Donard. Westward the eye rests on the rugged masses of Slieve Gullion and the Silurian hills of Newtown Hamilton. Towards the north, after passing the depression of the southern shore of Lough Neagh, and the valley of the river Blackwater, the enclosing ridge of old rocks, forming from this distance an apparently unbroken line, ranges northward into Donegal and the northern shores of Lough Foyle. The ocean now intervenes; but a comparison of the physical character of the Donegal mountains with those of Islay, Jura, Cantyre, and the Western Islands leaves the impression on my mind that the volcanic region of Antrim was limited northwards along the line of a submarine ridge, and that there is little reason for supposing that the volcanic rocks of Mull were superficially connected with those of this country,—on the contrary, the probability seems to be that the old crystalline rocks of the Western Highlands were interposed between the two regions.

Turning to the eastward, the sea overflows an area at one time occupied by volcanic products, but now only partially so, and we are unable strictly to define their easterly limits; but it is tolerably certain that the sheets of lava did not reach the shores of Galloway or those of the Isle of Man. Basaltic dykes, however, as is well known, traverse the north of England and the south of Scotland; but if referable, as Prof. Geikie concludes, to the Miocene period, they cannot be included in the volcanic region as here described and understood.

Thus the volcanic plateau of Antrim, like the Campagna of Naples, is washed on one side by the sea, and its limits become indefinable in consequence; but to the south, the west, and to some extent to the north, the limits of the region are marked out by mountains of considerable elevation. Within this region craters poured forth lavas or other volcanic products, which extended in great sheets until they were intercepted by the uprising of these natural barriers.

The floor of the area thus partially circumscribed was formed of various materials, as the accidents of denudation admitted. Over the central portions it was chiefly Cretaceous limestone (or Chalk), but to the southward it was New Red Sandstone and Lower Silurian, and to the north, Chalk, Lias, Carboniferous, and Lower Silurian beds in different directions. The whole region composed of rocks thus distributed was probably converted into dry land towards the close of the Eocene period—when, at various points, highly silicated felspathic lavas burst forth, consolidating into sheets of trachyte porphyry, rhyolite, and more rarely pitchstone, such as are found at Brown Dod Hill and Tardree, near Antrim, and west of Hillsborough. These trachytic lavas were therefore the oldest of the volcanic eruptions of the north of Ireland, and seem to have been represented by the newer granitoid rocks recently described by Zirkel, Geikie, and

---

* "The Malvern Hills compared with the Paleozoic districts of Abberley, Woolhope, May Hill, Tortworth, and Usk," Mem. Geol. Survey, 1849.

† An interesting memoir of the late Prof. Phillips will be found in the *Geological Magazine*, vol. vii. p. 301 (1870).

Judd in the Island of Mull on the one hand, and by the trachytes of Mont Dore in Central France on the other. They have been described in this district by Berger and Bryce; but it is only recently that their relations to the other lavas have been clearly determined; and as such rocks are exceedingly rare in the British Isles, I trust the members of the Association will take this opportunity of paying a visit to the quarries near Antrim, where they are fully opened to view. In composition, both at Hillsborough and at Antrim, they present a felspathic base, enclosing crystals of sanidine (or glassy felspar) and grains of quartz. At Brown Dod Hill they are disposed in sheets, showing lines of viscous flow and dipping beneath the overlying beds of basalt.

As I have already stated, the outpouring of these trachytic lavas may, with every probability, be referred back to the later Eocene period. At any rate, a considerable interval probably elapsed before the eruption of the next series of lavas of Miocene age, which are essentially augitic, and may be comprehended under the heads of basalt and dolerite with their amygdaloidal varieties. Sheets of these lavas were formed, from various vents, over the uneven surface of the older rocks, and to a far greater extent, both as to area and thickness, than in the case of the preceding eruptions of trachyte.* These beds, which are often vesicular, attain in some places a thickness of 600 feet, and are surmounted by decomposed lava and volcanic ashes, which mark the close of the second period of eruption.

The sheets of augitic lava which were poured forth during this stage are remarkable for their vesicular character and the numerous thin bands of red ochre (bole or laterite) which separate the different lava-flows, and which have been recognised by Sir C. Lyell as probably ancient soils formed by the decomposition of the beds of lava, similar to those in Madeira and the Canary Islands, resulting from streams of sub-aerial origin. Microscopic examination bears out this view; for a thin slice of one of the more compact beds of bole from the north coast showed that the felspar-prisms retained their form, while the augite and magnetic ingredients had passed into the state of an ochreous paste.

The vesicular and amygdaloidal character of these older beds of lava shows the probability that they have been poured forth under no greater pressure than that of the atmosphere, and together with the evidence derived from the bands of ochre leads to the conclusion that they have been erupted over land-surfaces. Some of the vents of eruption are now visible, either in the form of amorphous masses of trap protruded through the sheets, or of great funnels filled by bombs, broken pieces of rock, and ashes, such as the rock on which is perched the venerable ruin of Dunluce Castle (the ancient stronghold of the MacDonnells), or the neck erupted through the chalk in the coast cliffs near Portrush.† One of these old funnels was found by the late Mr. Du Noyer near this place: it forms a portion of the crest of the ridge overlooking Belfast Lough, to the east of Cave Hill, and is within easy reach of members of the Association.

The period of the formation of the older sheets appears to have been brought to a close by the discharge of volcanic ashes and the formation of an extensive lake, or series of lakes, over the region extending at least from the shores of Belfast Lough to the northern coast of Antrim, in which the remarkable beds of pisolitic iron-ore were ultimately deposited. This is the only mode of origin of these ores which seems to me at all probable; and I am consequently unable to accept the views advanced by Messrs. Tate and Holden regarding their origin from basaltic lava by a process of metamorphism. That water was present, and that the beds of ash which underlie the pisolitic ore were stratified, at least in some instances, is abundantly evident upon an examination of the sections at Ballypalidy, Ballymena, and the northern coast. In some places they are seen to be perfectly laminated in a manner that could only take place by the agency of water.‡ It would seem, therefore, that by the combination of slight terrestrial movements, a shallow basin was formed over the area indicated, which received the streams charged with iron in solution, draining the upland margins, from the waters of which were precipitated the iron, possibly by the agency of confervoid algæ, as in the case of the Swedish lakes of the present day (a view maintained by Mr. D. Forbes, F.R.S.), or by the escape of carbonic acid, owing to which the iron became oxidised and was precipitated.

Upon these uplands grew the plants whose remains occur amongst the ash-beds of Ballypalidy, the Causeway, and elsewhere, and which have enabled Mr. Baily to refer the strata in which they occur to the Miocene period.* In some places the vegetation crept over the surface of the former lake-bottom as it became shallower or was drying up, and gave rise to beds of lignite similar to those described by the Duke of Argyll as occurring at intervals amongst the basalts of Mull.† The beds of ore, wherever they are found, belong to one and the same geological horizon, and enable us to separate the basaltic series into two great divisions—one below and the other above the position of the pisolitic ore; and which, on maps of the Geological Survey, will for the future be represented by two different shades of colouring.

The ore itself is now laid open in numerous adits driven into the hill-sides, or in open works at Island Magee, Shane's Hill, Broughshane, Red Bay, Portfad, and other places,‡ whence it is transported to the furnaces of Scotland, Cumberland, Lancashire, and Wales. A new source of industry and wealth is rapidly springing up over the already prosperous county of Antrim, and ere many years are over we may expect to see furnaces established at several points for smelting the ores at the mines from which they are extracted.

The period of volcanic inaction just described was brought to a close by fresh eruptions of augitic lavas, which spread in massive sheets over the beds of ore, bole, and even lignite, without materially altering their constitution. Thus on the north coast a band of lignite is interposed between the pisolitic ore below and a massive bed of columnar basalt above, which can be followed and identified by the size and regularity of its columns for several square miles over that district. That this molten rock has not utterly reduced the lignite to ashes, or even entirely obliterated the impressions of the plant-remains, has been doubtless due to the rapidity with which a hard crust, of low conducting power, consolidates on the outside of a lava-stream, as has been frequently observed on Vesuvius and other active volcanoes.

Above this peculiarly massive bed were piled fresh sheets of basalt and dolerite to a total depth of at least 400 ft., each flow of lava being consolidated in a somewhat different manner from those above and below it, and probably separated from them by considerable intervals of time, as bands of ochre intervene in most instances between successive beds indicating subaerial soils of decomposed lava.

The maximum thickness of the basaltic sheets of Antrim has been estimated by Mr Duffin and myself at 1,100 ft., to which must be added perhaps 200 ft. for the subordinate trachytic beds, giving a total of 1,300 ft. for the whole volcanic series. This is rather more than originally assigned by Dr. Berger, who places it at 900 ft.,§ but it falls far short of the enormous accumulations of Mull, estimated by Prof. Geikie at from 3,000 to 4,000 ft.; in neither district, however, have we the data for determining the original thickness of volcanic *ejecta*, as in both large masses of material have been wasted away by denudation, and not a single volcanic cone or crater remains behind out of all those which, probably in numbers corresponding to those of Central France, were planted over the entire volcanic region.

The basaltic dykes which traverse not only the geological formations subordinate to the bedded traps, but also the latter themselves, are, in some districts, both remarkable and exceedingly numerous. To the south of Belfast Lough we find at Scrabo Hill an outlying mass of bedded dolerite resting on New Red Sandstone, and far beyond the limits of the main masses which rise in a fine escarpment to the north of the Lough. There is every probability that Scrabo Hill is the site of a distinct focus of eruption; but it is also remarkable for the dykes of trap, as well as intrusive sheets, which have been squeezed in between the beds of sandstone themselves. Admirable and instructive sections are laid open in the freestone-quarries of this hill, which will amply repay a visit. Another district remarkable for such intrusions is that of Ballycastle, where dykes and sheets are seen traversing the carboniferous rocks, as described by Sir R Griffith in his admirable report on the geology of that coal-field;* while the well-known Giants' Causeway is itself a tesselated pavement of columnar basalt, traversing in the form of a dyke the horizontal sheets of older formation.

---

* In this respect they resemble the corresponding rocks in Central France, where, as Mr. Scrope has shown, the trachytes have a more restricted range than the basalts ("Volcanoes of Central France")

† A sketch of this old rock is given by Prof. Geikie in Jukes's "Manual of Geology," 3rd edit p [illegible]

‡ The authors referred to, while admitting the stratified character of the beds at Ballypalidy and their formation in presence of water, consider that in all other cases the iron ore has been formed on a terrestrial surface; but sections seen at Ballymena and the north coast have led me to conclude that these beds are all more or less stratified, and due to aqueous deposition.

* Quart. Jour. Geol Soc, vol xxv p 357, pls 14 and 15. The plants determined by Mr Baily, from Ballypalidy, belong to the genera *Sequoia*, *Cupressites*, *Rhamnus*, *Quercus*, *Pinus*, &c. They were originally detected by the late Mr. Du Noyer

† Jukes's "Manual of Geology," 3rd edit. p 690.

‡ At Pleaskin Head it was originally observed by the Rev. Dr. Hamilton (1790)

§ Trans. Geol. Soc, 1st Series, vol. iii.

The intrusion of the thousands of dykes of the north-east of Ireland is unaccompanied by crumplings or contortions of the strata; and if it were possible to place the dykes side by side, their aggregate breadth would cover a space several thousand feet in breadth. How, then, has this additional space amongst strata of given horizontal dimensions been obtained? Has it been by lateral tension outwards owing to inflation by means of elastic gases or vapours, or by a general bulging of the surface consequent on lateral pressure? The former view, I am told by physicists, is untenable; the latter is one which will probably prove more consonant with modern views of terrestrial dynamics.

The results of the microscopic examination of a considerable number of specimens of augitic lavas from various parts of the volcanic districts are of a generally uniform character. Whether we take specimens from the largely crystalline granular dolerites of Portrush or Fair Head, or the very dense micro-crystalline basalts of Shane's Castle, the structure and composition are found to be nearly uniform.

The lava is, with very few exceptions, an amorphous or sub-crystalline paste of augite, enclosing long prisms or plates of labradorite felspar, crystalline grains of titano-ferrite, and often of olivine. Chlorite is also sometimes present as a "secondary" mineral. It will be observed that this diagnosis differs essentially from that assigned by Dr. Zirkel as the normal structure of basalt, in which the base is "a glass," and the other minerals (the augite, felspar, and olivine) are individually crystallized out.† This, indeed, is the case with the carboniferous melaphyres of the south of Ireland,‡ and probably with all the rocks in which augite is deficient; but the basalts of Antrim contain augite so largely in excess of the felspar that it has, in nearly every case, formed the base of the rock.§

The basalt itself is often so rich in iron as to become an impure iron-ore. This is owing to the presence of the metal in the form of minute grains of titaniferous iron-ore, which is the principal cause of the black appearance of the rock and also as one of the components of the augite.

From the above general review of the volcanic history of Tertiary times in the north of Ireland it will be evident that it presents us with three distinct periods, similar to those which Mr. Judd has recognised in the succession of events in the Island of Mull:—

The earliest, possibly extending as far back as the later Eocene period, characterised by the trachytic lavas.

The middle, referable to the Miocene period, characterised by vesicular augitic lavas, tuffs, and plant-beds.

The latest, referable to a still later stage of the Miocene period, characterised by more solid sheets of basalt and numerous vertical dykes.

These three stages were probably separated from each other by long intervals of repose and the cessation of volcanic action. The succeeding Pliocene period seems to have been characterised by considerable terrestrial movements, resulting in the production of fractures in the earth's crust, and (as my colleague, Mr. Hardman, supposes) in the formation of that large depression which was filled with waters having a greater area than the Lough Neagh of the present day. Some of the faults which traverse the upper sheets of basalt, and are therefore of later date, have vertical dislocation amounting to 500 or 600 ft., as, for instance, that which runs along the valley under Shane's Hill near Larne. Such great fractures must necessarily have been accompanied by denudation, and it is probable that many of the present physical features had their origin at this (Pliocene) period. The extent to which the original plateau of volcanic rocks has been broken up and carried away within such comparatively recent times is vaster than is generally supposed. As there is evidence that the sheets of lava to the north of Belfast Lough were originally connected with those of Scrabo Hill to the south, we must suppose that this arm of the sea and the valley of the Lagan have been excavated since the Miocene period; while on the north-west the high elevation to which the escarpment of the basalt reaches, leads to the supposition that the basaltic sheets spread over the ground now occupied by Lough Foyle. Both along the west and along the eastern seaboard the sheets of lava are abruptly truncated, and must have extended far beyond their present bounds; while many deep valleys, such as those of Glenarm, Cushendall, and Red Bay, have been excavated.

But the most remarkable result of the denudation, as bearing upon the subject before us, is the complete obliteration of the volcanic cones which we may well suppose studded the plateau. Some of these cones, at least, were contemporaneous with those now standing upon the granitic plateau of Central France, and which are but little altered in elevation since the fires which once burst forth from them became extinct. But since then the north of Ireland has been subjected to vicissitudes from which Central France has been exempted. The surface of the country has been overspread by the great ice-sheet of the earliest stage of the Glacial period, which appears to have stretched across from the Argyleshire Highlands, if we are to judge by the direction of the glacial *striæ* at Fair Head.*

At a later stage the country was submerged beneath the waters of the Inter-glacial sea which deposited the sands and gravels which overlie the Lower Boulder-clay; and subsequent emergences during the stage of the Upper Boulder-clay, together with atmospheric agencies constantly at work, whenever land has been exposed, have moulded the surface into the form we now behold.

It will thus be seen that the physical geologist, whether a Vulcanist or a Neptunist, has in this region abundant materials on which to concentrate his attention.

Volcanic Energy.—In connection with this subject it may not unnaturally be expected that I should make some allusion to the views of Mr. Robert Mallet on "Volcanic Energy," which he has recently unfolded in the "Philosophical Transactions of the Royal Society."† My limits, however, forbid more than a cursory glance at this subject. Stated in a few words, volcanic energy, according to Mr. Mallet, has its origin primarily in the contraction of the earth's crust, due to secular cooling and the tendency of the interior molten matter to fall inwards and thus leave the exterior solid shell unsupported. The lateral pressure arising therefrom (which, as Mr. Mallet shows, is vastly greater than the vertical weight of the crust) is expended in crushing portions of the solid crust together, along lines of fracture which are supposed to correspond to those of the volcanic cones which are distributed over the earth's surface. Each successive crush produces an earthquake-shock, and is converted into heat sufficient to melt the rocks which line the walls of the fissure or lie beneath at high temperatures, and which, in presence of elastic steam and gases, are erupted at intervals both of time and place.

In the words of the author of these views, "The secular cooling of the globe is always going on, though in a very slowly descending ratio. Contraction is therefore constantly providing a store of energy to be expended in crushing parts of the crust, and through that providing for the volcanic heat. But the crushing itself does not take place with uniformity; it necessarily acts *per saltum* after accumulated pressure has reached the necessary amount at a given point, where some of the unequally pressed mass gives way, and is succeeded perhaps by a time of repose or by the transfer of the crushing action elsewhere to some weaker point."

It cannot be denied that Mr. Mallet's theory seems to be consistent with many observed facts connected with volcanic action. It has for its foundation an incontestable physical hypothesis, the secular cooling of the earth, and it seems to throw considerable light upon several observed phenomena of volcanic action—such as the distribution of cones and craters along great lines, the intermittent character of eruptions, and the connection of earthquake-shocks with volcanic outbursts. There are some statements in Mr. Mallet's paper which few physical geologists will be inclined to accept, such as the non-existence of true volcanoes before the Secondary or Mesozoic period. The Silurian volcanic districts of North Wales and of the west of Ireland, and the Carboniferous volcanic districts of Limerick and Scotland, bear witness against the soundness of such a view. This statement, however, does not necessarily invalidate the general views of the author; and I cannot but think that the publication of Mr. Mallet's paper has enabled us to take a very long stride in the direction of a true theory of volcanic energy.

---

* "Geological and Mining Survey of the Coal Districts of Tyrone and Antrim" (1829). Some of the sheets in this district may be of older date than the Miocene age.

† "Untersuchungen uber d. mikrosk. Zusammensetzung und Structur der Basaltgesteine" (1870)

‡ E Hull, "On the Microscopic Structure of the Limerick Carboniferous Melaphyres," Journ. Roy. Geol. Soc. Ireland, vol III p. 112 (with plates)

§ Mr. Allport, F.G.S., states (Geol. Mag. 1873) that he has found the augite individually crystallised out in a specimen from near the Causeway. Such a case, however, must be exceptional; but the rule as stated above certainly holds good.

* A view also held by Mr James Geikie and Mr. Campbell of Islay.

† 1873, vol. clxiii. p. 147.

SECTION D

BIOLOGY

OPENING ADDRESS BY PROF. PETER REDFERN, M.D., PRESIDENT

I CONSENTED to allow myself to be nominated President of this Section in compliance with the kindly-expressed wishes of scientific friends, notwithstanding that I felt that the duties of the Chair would have been more fitly discharged by many who have attended the meetings of the Association more regularly and laboured to promote its objects more continuously than I have been able to do.

Fortunately the increasing importance and the vast extent of the subjects comprised under the head of Biology have led to a division of the business of this Section into the separate departments of Anatomy and Physiology, Botany and Zoology, and Anthropology; and it is a great relief to me that the departments of Botany and Zoology, and of Anthropology, respectively, will be presided over by gentlemen of the highest eminence in those subjects, and that Anatomy and Physiology, in which I am more immediately interested, will alone come under my direct supervision. It has occurred to me that, in attempting to give a stronger impulse and a more systematic direction to scientific inquiry, the time ordinarily devoted to an introductory address could not be more profitably occupied than by bringing into as great prominence as possible some of the great revolutions in our knowledge of Anatomy and Physiology which have taken place in my own time and under my own immediate observation.

I remember, as if it were yesterday, the elucidation in the Museum of the Royal College of Surgeons of Edinburgh of the newly discovered cell-theory by the late distinguished Professor of Anatomy in Edinburgh, John Goodsir—his account of the production of ulceration by cell-growth, of the characters of the corpuscles of bone, of the structure of lymphatic glands, and of the germinal centres of basement membranes as they were then understood. This was the time when the teaching of Histology was first established in Great Britain. Two students, of whom I was one, formed the first class under the most enthusiastic of teachers, my old friend Dr. Hughes Bennett. The University of Edinburgh had just passed through what was probably the most brilliant period in its history. The race of the last of the Munros was well-nigh run; the great discoverer of the difference in the motor and sensory nerves, Sir Charles Bell, was still living; the aristocracy of Scotland had only just ceased to crowd the classroom and witness the brilliant and successful experiments of Dr. Hope. The day of Cullen, of Home, and Duncan, and Macintosh was over; but there still remained in the University the most loved and revered of teachers, the benevolent Dr. Alison, Sir Robert Christison, Sir George Ballinghall, and Mr. Syme; Dr. Abercrombie still practising his profession in the city.

At this period the great discoveries of Schleiden and Schwann seemed likely to upset all that had previously constituted Physiology. The idea that all tissues were either composed of cells or had been formed of cells—that nucleated cells elaborated all the secretions and formed the excretions—that their energy lay at the very root of the formation, the reproduction, and the function of every tissue and organ, was a revelation of such astounding simplicity as might well upset men's minds and prevent their seeing beyond.

No one, who did not live through that time, will, I believe, ever realise the eagerness and anxiety with which every new statement of the action of cells was received and added to the previous knowledge of their amazing power—or, on the other hand, be able to judge of the feeling, half akin to disappointment, which was experienced as each succeeding attack was made on this charming theory, showing it to be really human, very human indeed.

Cells were then understood to constitute the mass of all organs (the liver, spleen, kidney, and brain), and to be the main agents in the discharge of their functions—to exist and grow upon the definite membranous walls of the glandular vesicles and ducts—to be fed by blood brought to the attached surface of membranes which seemed almost everywhere to form an absolute separation of the cellular part (the potential gland) from the non-essential blood and lymph-vessels, the nerves and framework of the organ. It seemed almost a pity that these little microscopic deities should be hampered by the necessities of their own existence, that they should need such base things as blood-vessels, nerves, and packing materials. Now how strangely are matters changed! What if it should turn out that these apparently independent little beings are not independent at all—that they are only the dilated ending of nerves? To this subject I shall refer again by and by.

This great cell-theory has now given place to what I think is certain knowledge, that living matter may move, perform all the functions of assimilation and nutrition, and reproduce its like without having any of the essential characters of a cell. A living mass of protoplasm may change its shape, alter its position, feed and nourish itself, and form other matter having the same properties as it has, and yet be perfectly devoid of any structure recognisable by the highest powers of the microscope.

Mr. Lister showed that the contraction of pigment cells in the skin changes the position of the pigment granules, driving them alternately into the processes and the body of the cell. Kuhne, Golubew, and Stricker observed changes of form in amœbæ (white blood-corpuscles and embryonal capillaries, respectively) after the application of electrical stimuli; and Brucke observed contraction in the pigment-cells of the skin of the chameleon after excitation of the sensory nerves; whilst Kuhne noticed contraction in corneal cells after excitation of the corneal nerves.

Thus obvious movements in fixed cells or masses of protoplasm are proved to result from the operation of various stimuli, including nervous stimuli.

But all cells are not fixed. The blood-cells, fixed, as cells of organs, at an early period, become free in the blood-fluid and are moved along by the forces which circulate it until a second time they enter into the composition of the solid tissues by penetrating the walls of the blood-vessels and moving along the substance of the tissues for purposes which are not yet wholly explicable.

What naturalist will not at once suggest how frequently this process of alternate fixation and movement of animal forms occurs low down in the scale? and yet how startling is it in man! how impossible to reconcile with our former ideas of the existence of membranous coverings, of cells, surfaces, and of gland-ducts! But, with or without explanation, the facts must be recognised; the floating blood-cells are really the very cells which once formed the substance of the lymphatic glands, the spleens, and other organs; and they do, in fact, move through the walls of the blood-passages, and wander about freely in what we call solid tissues.

Our knowledge of this circulating fluid has marvellously increased. The duration of the life of any of its particles is but short; they die and their places are occupied by others, as was the case with our forefathers, and will be the case with ourselves. It is now a matter of observation, which commenced with Hirt of Zittan, that after every meal an amazing number of white corpuscles are added to the blood: breakfast doubles their proportion to the coloured corpuscles in half an hour; supper increases their proportion three times; and dinner makes it four times as great. They come from such solid glands as the spleen. In the blood going to the spleen, their proportion is one to two thousand two hundred and sixty; in that returning from the spleen it is one to sixty. Every organ and every tissue changes this fluid; and, to my mind, perhaps the most stupendous miracle of organisation is the steady maintenance of but slightly variable characters in the living and moving blood which is every moment undergoing changes of different kinds as it circulates through each tissue and organ in the body.

Yet with all this change there is an invariable transmission of the parental characters by continual descent from particle to particle as each takes the place of a former one; and thus each organ continues to discharge the same function from year to year. Animals of the same kind retain the old number of organs, the same shape of body, and similar modes of life. There is no sign of commencing life, no coining of new vital power, no production of living out of dead matter. The original life extends its limits; it operates in a more extended sphere; but it is the same life, it operates in the same way, it never fails to be recognisable in the individual by the same characters as it had when it was first known. Whatever other functions it discharges, it acts continually in obedience to the first great law; it increases and multiplies, and replenishes the earth.

Let us now for a few moments compare our former views of the structure of animal membranes with the present ones. The skin (covering the outer surface of the body), the mucous membranes, the serous linings of the great internal cavities and of the blood- and lymph-vessels, and the lining membranes of joints, were all alike viewed as if formed of a definite membrane covered on one side by cells, and on the other supplied by blood- and lymph-vessels and by nerves—the membrane covering in the latter parts and effecting an absolute separation of the cells from the vessels and nerves, which were universally believed never to penetrate into the cellular layer. The cells were regarded as the parts actively engaged in the performance of the functions, the vessels and nerves aiding thereto supplying materials to be acted on by the cells, and the nerves regulating the amount of action at particular times for special purposes. The diseased conditions, like the functions, were kept perfectly distinct; and we had one set of diseases of the epithelial or cellular parts, and another and a different set of diseases of the membranes and of the parts below.

I think the first occasion on which the public faith in these views was seriously shaken was when the late distinguished Professor of Medicine in St. Andrew's, Dr. John Reid, died of what was called an epithelial cancer of the tongue. Microscopical examinations showed that the disease existed in the cellular covering of the tongue. A sufficient cause for it was supposed to exist in the irritation caused by sharp points of the teeth, to cover which a protecting silver plate was constructed. The diseased parts were removed with the greatest skill and care by Sir William Fergusson, and subsequently by the late Dr. James Duncan, assisted by Mr. Goodsir and Mr. Spence, now Professor of Surgery in the University of Edinburgh. Every conceivable care was taken by these attached friends of the poor sufferer to remove every trace of the disease; but it progressed steadily and destroyed his valuable life.

At this period no one could understand the extension of an epithelial disease through a basement membrane; and therefore the affection of the adjacent lymphatic glands was explained by supposing the diseased action to have been propagated from cell to cell along the epithelial surface of the lymphatic vessels.

Not long afterwards the sternly truthful and accurate Sir James Paget declared, in terms of terrible significance, to the sufferers from this disease, that epithelial cancer takes a little longer time than ordinary cancer to do its fatal work.

And it soon became thoroughly well known that the glands of the skin, the hair-bulbs, and the teeth are produced by a local development of the deep cells of the cuticle, extending far below the line of the basement membrane or cutis, and through the position which it was supposed to occupy, as though no membrane were there to hinder them.

Thus the basement membrane, which was supposed so arbitrarily to separate the cells on one surface of membranes from the vessels and nerves on the other, gives way at once before an increased development of the cells, whether in the formation of new organs or the extension of disease. And the membranous walls of capillary blood-vessels allow the corpuscles of the blood to pass through them much in the same way as solid particles enter into and traverse the substance of the protoplasm of an amœba or other mass of sarcode.

Whilst physiologists were engaged in these observations, the late Master of the Mint, Mr. Graham, was conducting a series of experiments of the most remarkable kind, and of the utmost importance to physiology as well as to chemistry and physics. He found it necessary to separate the two sets of substances as crystalloids and colloids—the colloids being penetrable by the crystalloids as readily as water, the crystalloids (such as hydrochloric acid and common salt) passing through organic membranes with great freedom, whilst many of the colloids, such as albumen and gum, will not penetrate them at all. This discovery has enabled the chemist to separate crystalloids from colloids by dialysis, even when they occur in the most minute proportions—for instance, to separate 80 or 90 per cent. of a ten-thousandth part of arsenious acid in twenty-four hours from porter, milk, or infusions of viscera, substances notoriously difficult to analyse. And it has enabled physiologists to explain how animal membranes are traversed by various substances which could not pass through them without being changed from the colloidal into the crystalloidal form. Thus the colloidal starch and albumen of our food scarcely admit of absorption until in the process of digestion the starch becomes sugar and the albumen albuminose, crystalloidal bodies which pass through animal membranes with great facility. And again, this crystalloidal albuminose, after having passed into the tissues through the membranous walls of the vessels, may become a second time a colloid, and be deposited and fixed as tissue-substance, ready in its turn to be permeated by crystalloids either for temporary or more durable purposes in the economy.

The effect of this great economy of Mr. Graham's shows how impossible is the advance of physiology without a corresponding advance in our knowledge of chemistry and physics.

If basement membranes, the walls of blood-vessels, and of cells are made up of colloidal matter, we can easily understand how they are penetrated by crystalloids; and in like manner it is perfectly possible that they may be traversed by other substances in solid forms—as, for instance, the walls of blood-vessels by the corpuscles of the blood. No wonder that there is a continual deposition and removal of the constituents of the tissues, if so slight a change as that from the crystalloidal to the colloidal form, and the reverse, makes such perfectly marvellous differences in the relations of these substances to each other.

We must look upon the tissues of an animal body as we do upon the substance of an amœba, and recollect how penetrable the surfaces and tissues of animals are; then we shall cease to be startled when we see these parts become the seat of entirely new deposits, or find them traversed by migrating blood-corpuscles as freely as a colloid is penetrated by a crystalloid.

It is impossible to foresee what may be the result to physiology of this great advance in our knowledge of the varying relations of substances to each other according as they present themselves at different times in the opposite physical conditions which were described by Mr. Graham as crystalloidal and colloidal. But it is plain that we cannot continue to look upon animal membranes as forming such decided barriers against the penetration of one tissue by another, or by foreign matters, as was once supposed.

Let me now direct your attention to the present aspect of the question how far basement membranes limit the distribution of vessels and nerves, and separate them from the cells of glands and membranes.

Mr. Bowman, in his admirable researches into the anatomy of the organs of sense, discovered that the filaments of the nerves of smell have a remarkable structure—that they are nucleated, finely granular, contain no white substance of Schwann, and resemble the gelatinous nerve-fibres. The epithelial surface, too, of the olfactory region Mr. Bowman described as differing greatly from that of the adjacent parts of the nasal mucous membrane, and as being of a dark sepia tint. Subsequent examinations by Hoyer, Max Schultze, and Lockhart Clarke confirmed these statements; and those of Schultze demonstrated that the cells are of two kinds, one elongated and filled with yellowish granular protoplasm, exposed at the outer end of each cell and containing a clear oval nucleus in clear protoplasm in its deeper part, which is first attenuated and then expanded into a broad flattened process, apparently connected with the connective tissue; the other cell, the proper olfactory cell, a thin, fibrous, rod-like body, is moniliform or varicose, connected below with the out-runners of a nerve-cell, and in birds and amphibia furnished with one or more hair-like processes, which at the free end come directly into contact with odorous particles. Exner in 1872 denied the distinctness of these two forms of cells, stating that there are all intermediate forms, and that both forms are connected with a deep network continuous with filaments of the olfactory nerve. But Dr. Newell Martin, in a paper published in the November number of the *Journal of Anatomy and Physiology*, maintains that the two kinds of cell are distinct, though their characters approximate very closely in the instance of the frog. He inclines to the belief that, as both forms of cell are so distinct from ordinary epithelium, they are all olfactory cells.

The only conclusion which can be drawn from these observations is, that in this situation the olfactory nerves divide into myriads of small finger-like processes, which, exposed on the free surface of the membrane, are actually engaged in feeling at the odorous particles to inform us of their characters.

This single instance, so thoroughly proved, would be sufficient to destroy our former ideas that nerves are spread out under basement membranes and never penetrate an epithelial layer.

But this is not the only case of this kind. The general relations of the gustatory nerves to the epithelial cells of the tongue have been described by Axel Key as similar in the fungiform papillæ of the frog, and by Schwalbe and Lovén in the gustatory cells of the circumvallate and of some of the fungiform papillæ in men and animals. On the protected sides of the circumvallate papillæ a peculiarity in the shape and arrangement of the epithelial cells produces a series of taste-cones, the central cells of which are furnished with hair-like prolongations similar to those of the olfactory cells.

In the otolith sacs and the ampullæ of the semicircular canals of the ear, the nerve-filaments, having lost their white substance, become connected with peculiar auditory cells and end in hair-like processes between the epithelial cells. In the cochlea, too, notwithstanding the complication of the examination produced by the rods of Corti, there is reason to believe that the cells supporting hairs which project beyond the epithelial surface are connected with the primitive nerve-fibrils of the plexus below.

Of the recorded instances in which nerves pass through basement membranes to get into direct contact or continuity with the superjacent epithelial cells, none is so striking as that of the salivary and other glands, if there be the least ground for the remarkably detailed observations and suggestions of Pfluger. They are of so much importance and interest in connection with the whole process of secretion, that I offer no excuse for directing your attention to them, even though it may be proved that the act of secretion is not attended with such marvellous and extensive changes of structure as Pfluger supposes. Up to a certain point his observations may be easily and abundantly confirmed; beyond that there is much greater difficulty; but this meeting offers one of the most favourable opportunities for extending our knowledge by bringing different observers into easy communication with each other, and enabling each to help the rest by stating the means by which he had overcome what seemed at first to be insuperable difficulties in the progress of an investigation.

Pfluger calls attention to the very variable characters of the alveoli, the secreting cells, and the excretory ducts of the salivary glands. These parts, which were believed to have very determinate sizes and characters, he declares to differ very greatly in different parts of the same gland. The alveoli, occupied by what we understand as secreting or glandular epithelial cells, and the excretory ducts, lined by columnar epithelium, he thinks he can prove to be but different stages of development of the same structures, produced on the ends of the myriad nervous filaments supplied to these glands.

On this view glandular epithelial cells must be regarded as special organs of termination of nerve-fibrils, like the auditory cells, touch-corpuscles, olfactory cells, muscular fibre-cells, and the like; the relation between such structures and the nerves becoming so close that it may be difficult, perhaps impossible, to define their respective limits. Pfluger has figured the nuclei of the cells of the alveoli of the salivary glands, the salivary cells, connected with a delicate fibre, which often pierces the surface of the cell in contact with the *membrana propria*, and gives the cell the appearance of being stalked. This appearance has also been seen by Schlüter, Otto Weber, Gianuzzi, Boll, and Kolliker; and indeed the appearance which Pflüger has figured may be seen by anyone who will take the trouble to examine the salivary glands of the common cockroach (*Blatta orientalis*). This process was shown to me by my friend and pupil, Mr. Charles Workman; and I have several preparations which show a similar process to that which Pfluger has observed and figured; but that it is as clearly connected with the nucleus of the cell as he describes it I am not prepared to affirm. Pfluger says it is hollow, and often discharges a large quantity of tenacious material which clearly proceeds from the nucleus.

In the interior of the gland there are ducts lined with a thick but single layer of columnar epithelium, the cells of which are clear and nucleated near their free end, but furnished with a large number of extremely fine varicose hairs at the end connected with the *membrana propria*. This epithelium becomes thicker as the ducts proceed towards their connection with the alveoli; and as transparent drops can be seen transuding from the ends of the cells when saliva has been made to flow by irritation of the gland, Pfluger concludes that they are important secretory organs. Such ducts frequently form loops, or bend suddenly, or possess diverticula. The epithelium of the ducts, which carry the secretion out of the gland, is of a different and apparently less important kind.

Pflüger directs special attention to the great number of nerves connected with the alveoli. He has identified them in fresh specimens by their investment here and there by an ordinary double-contoured medulla, by their being blackened by perosmic acid, by their varicosities, and by tracing them to large and more easily recognisable nerves. He finds them branching in great numbers amongst the cells of the alveoli, and traces their fibrils to the nuclei of the cells, sometimes after they have been connected with multipolar ganglion-cells. Or nerves covered by medulla and sheath, and containing numerous varicose axis cylinders, branch, enlarge, and become covered with protoplasm set with nuclei, forming what Pfluger calls a protoplasmic foot, and supposes to be a structure intermediate in character between nervous and glandular tissue. And on the surface of the ducts lined by columnar epithelium a nerve divides into a pencil-like tuft of varicose fibrils, each of which Pfluger says is directly continuous with one of the processes of a columnar epithelial cell. I have frequently seen the pencil-like tuft of varicose fibrils on the surface of the ducts lined by columnar epithelium; but it is not so easy to be sure that the fibrils are connected with the processes of the cells. However, the statement is made in the most positive way by Pflüger, who has made these glands the subjects of very special and lengthened investigation; and his drawings afford very strong corroborative testimony of the value of his statements. Moreover, in independent observations on the pancreas, he has also traced the nerves to endings in the secreting cells.

But Pfluger has gone greatly further than this. He has figured the hair-like processes at the attached end of the columnar cells in all stages of transition into salivary cells of new alveoli; and having previously found the nerves connected by varicose fibrils with protoplasmic masses set with nuclei, he concludes that it is possible that the salivary cells are developed on the ends of the nerves without interference of their own nuclei, and that, as a continual new formation of alveoli and salivary cells implies the atrophy and disintegration of corresponding older parts, the alveoli with pale offshoots of various forms which he has seen in moles are evidences of such atrophy.

With these numerous instances in which nerves are alleged to pass through membranes to be connected with the cells on their surfaces, as if these were their special modes of termination, we might well be content until there has been time for further investigation by independent observers. But there are yet other instances. Langerhans described, in 1868, a fine network of fibres in the skin, from the superficial part of which fine non-medullated fibres pass out of the cutis and end in the Malpighian layer of the epidermis. He saw in the epidermis also well-marked cells which gave off several processes towards the horny layer, and one long slender process which passed through the Malpighian layer into the cutis. He considers these cells to be nervous, and their peripheral processes to be the terminal parts of the nerves of the skin. C. J. Eberth agrees in the main with Langerhans, and recognises fine nerve-fibres passing from the nerves of the cutis into the deeper layer of cuticular cells, and also star-and-spindle-shaped cells in the cuticle, which he suggests may be nervous structures, though he has not traced them in connection with nerve-fibres.

On the surface of young fishes and Amphibia F. E. Schutze has described nerve-hairs arranged in the form of tufts or brushes very much as is the case in the organ of hearing; in this instance the brush-like endings of the nerves are probably connected with touch.

Cohnheim has described the corneal nerves as forming a superficial plexus under the anterior elastic lamina; from this perforating branches pass perpendicularly through the lamina, and then under the epithelium, break up into brush-like or star-shaped finer branches, which form a plexus giving off fine nerves at tolerably regular intervals between the deep columnar cells and the more superficial spheroidal ones, and dividing at length into their finest branches, which end by somewhat swollen extremities in the most superficial epithelial layers. Thus the exquisite sensibility of the front of the eye, like that of the olfactory or gustatory mucous membranes, may be accounted for.

When I look upon the vast amount of research which has been applied to this department of biology for some years past, and think that the instrument which has afforded the great means for it was only perfected so as to be capable of use for such purposes about 1820, I cannot but congratulate the Section on the abundant fruits we are reaping.

And when, in addition, I contemplate the amount of certainty which physical science has imparted to physiology by furnishing the means of examining and accurately measuring the rates of transmission of nerve-currents, of obtaining tracings of the respiratory movements and of the arterial pulsations, of examining the retina in the living eye and the larynx of a living man almost as readily as if these parts were exposed in a dissection, I cannot but conclude that this nineteenth century has already been distinguished as a very notable one for biology, and especially for physiology.

Considering that so much time is required for making a single careful observation, it is very fortunate that so large an array of inquirers and so much talent are employed upon the subjects in which we are interested, and that once a year we have this admirable opportunity of listening to the results of inquiries instituted by the most eminent men in all parts of the world, and of hearing different views advocated with the greatest earnestness and yet with perfect good humour, and a rigorous determination to rest satisfied with nothing but the truth.

SCIENTIFIC SERIALS

Proceedings of the Berwickshire Naturalists' Club.—This is the first part of a new volume of the always welcome proceedings of this almost venerable club, which, although nominally a "Naturalists' Club," concerns itself not only with all departments of natural history, but also with subjects of antiquarian, archæological and general historical nature. This part of the Proceedings especially contains a very large proportion of papers on the antiquities and history of the district worked by the club. As usual, the annual address of the president, Dr. Charles Stuart, consists of a summary of the proceedings of the club during the previous year, and as the proceedings take place mostly in the open air, in spring and summer, the president's address is almost always bracing and interesting, and full of information; it is so in the present case. One of the longest papers is by Dr. George Johnston, having a description of a visit to Holy Island in May 1854, and contains a great deal of interest on the history, natural history, and curiosities of that historical islet; appended is a list of the plants and animals which were seen during the visit. Mr. James Hardy has a large number of papers in this part; of his more strictly scientific contributions are the "History of some Bass Plants," "Arrival, Departure, and Local Migration of Birds near Old Cambus, 1873," "On Insects of East Berwickshire," "Contributions to the Entomology of Cheviot Hills, No. IV." Under the head of "Hawick and its Neighbourhood," we have the geology of the Hawick district by Prof. James Elliott, and its prehistoric antiquities by Dr. Bryden. Mr. John Anderson gives a list of Lepidoptera taken at various places in the south-east of Scotland in 1873, and Mr. A. Kelly the Habitats of some Berwickshire Birds. There are three contributions on *Poa Sudetica* by Mr. A. Brotherton, Mr. A. Kelly, and Mr. J. Hardy. Mr. Brotherton also contributes "Zoological Notes, 1873," and a "List of Tweedside Plants, mostly of recent introduction." Sir Walter Elliot has an interesting obituary of the late Dr. T. C. Jerdon, who wrote so largely on Indian natural history. We have not space to refer to the interesting historical and antiquarian papers.

SOCIETIES AND ACADEMIES

GOTTINGEN

Royal Society of Sciences, March 7.—M. Wieseler read a paper On the Surname "Asphaleios" as applied to Poseidon.—Dr. Drude presented a note On the Systematic Position of Schizocodon, a genus created by Siebold, to which some plants found in the highlands of Japan are referred. The author regards Schizocodon as an anomalous Primulacea, allied to Soldanella, and clearing up the relationship between the Primulaceæ and the Polemoniaceæ.—Dr. Carl Fromme made a communication On the magnetisation-function of a ball of soft iron, *i.e.* the magnetic moment obtained in a ball of unit volume by unit magnetising force.—M. Nöldeke communicated a note On the Greek Names of Susiana.—M. Bjerknes have a generalisation of the problem of motions produced in a still inelastic fluid by the motion of an ellipsoid.

PARIS

Academy of Sciences, Aug. 10.—M. Bertrand in the chair. The following papers were read:—On a new memoir by M. Helmholtz, by M. Bertrand.—Studies on the fossil grain found in a silicified state in the coal formation of Saint Etienne, by M. Ad. Brongniart.—Note on the isthmus of Gabès and the eastern extremity of the Saharan depression, by M. Edm. Fuchs. The author speaks in unfavourable terms of the scheme for establishing a central sea in Algeria.—Fifth note on the conductivity of ligneous bodies, by M. Th. du Moncel.—Researches on explosive bodies; explosion of powder; by MM. Noble and F. A. Abel. Second memoir.—Actual state of the invasion of *Phylloxera* in the Charente provinces: extract from a letter from M. J. Girard to the perpetual secretary.—On the employment of flax waste against *Phylloxera*: a letter from M. La Perre de Roo to M. Dumas.—Vines attacked by *Phylloxera* treated by sand: extract from a letter from M. L. Faucon to M. Dumas.—Note on Coggia's comet, by MM. Wolf and Rayet. The authors made two determinations of the wave-length of the central and most brilliant band in the spectrum. The results are—July 1st, 5161; July 6th, 5165.—Observations of Coggia's comet (III. 1874) made with the Secrétan-Eichens equatoreal, by M. Baillaud.—Observations of Borrelly's comet (IV. 1874) made with the Secrétan-Eichens equatoreal, by M. Wolf.—On the application of gilding on glass to the construction of the camera lucida, by M. G. Govi.—Stratification of the electric light, by M. Bidaud.—On decolorising charcoals and their artificial production, by M. Melsens.—On the constitution of clays (second note), by M. Th. Schloesing.—Estimation of tannin, by MM. A. Muntz and Ramspacher. The authors allow the tanning solution to pass through a piece of hide, and estimate the amount of matter removed by loss.—Note relating to the action of muscarine (toxic principle of *Agaricus muscarius*) on the pancreatic, biliary, and urinary secretions, by M. J. L. Prevost.—On an arrangement of apparatus permitting the recovery of the iodine which is disengaged during the manufacture of "superphosphate of lime," by M. P. Thibault.—On the etherification of glycol, by M. Lorin.—On a solid polymeride of the essence of terebenthene, tetraterebenthene, by M. J. Riban. This substance is obtained by the action of antimonious chloride upon terebenthene.—On the albumens of the white of egg, *à propos* of a reclamation of M. Arm. Gautier, by M. A. Béchamp.—Analysis of different pieces of beef sold in the Paris market in 1873, by M. Ch. Mène.—On the Annelids of the Gulf of Marseilles, by M. A. F. Marion.—On the Echini from the environs of Marseilles, by M. V. Gauthier.—On the dressing of wounds with phenic acid (according to Dr. Leister's process), and on the development of vibrios in the wounds, by M. Demarquay.—On the scales of the lateral line in different percoid fish, by M. L. Vaillant.—On the influence of forests on the quantity of rain which a country receives, by MM. L. Fautrat and A. Sartiaux.—On the age and position of the white statuary marbles of the Pyrenees and Alps, by M. A. Coquand.

BOOKS RECEIVED

BRITISH.—British Wild Flowers, Part I: Sowerby and Johnson (Van Voorst).—Reclamation and Protection of Agricultural Land: David Stevenson (Black).—Proceedings of the Manchester Literary and Philosophical Society, vols viii. ix. x.—Memoirs of the Manchester Literary and Philosophical Society, vol. iv., 3rd series.—How I found Livingstone in Central Africa: H. M. Stanley. Cheap Edition (Low).—Twelfth Annual Report of the Birmingham Free Libraries Committees.—On the Modern Hypothesis of Atomic Matter and Luminiferous Ether: H. Deacon.—Proceedings of the Bristol Naturalists' Society, 1873.—Divine Revelation; or, Pseudo-Science: R. G. Suckling Browne (Longmans).—Tyer's Block Telegraph and Electric Locking Signals. 5th edit. (Tyer & Co.).—The Human Eye: W. Whalley (J. and A. Churchill).—Physiology of the Circulation: Dr. Bell Pettigrew (Macmillan & Co.).—Researches in the Life History of the Monads: W. H. Dallinger and J. Drysdale, M.D.—Journal of the Iron and Steel Institute, vol. i. (Newcastle).—Treasury of Natural History. New Edition (Longmans.)

CONTENTS

PAGE
SCIENTIFIC WORTHIES, IV.—JOHN TYNDALL. By Prof. HELMHOLTZ (*With Steel Engraving*) 299
GROVE'S "CORRELATION OF PHYSICAL FORCES." By Prof. J. CLERK-MAXWELL, F.R.S. 302
FIRST FORMS OF VEGETATION 304
LETTERS TO THE EDITOR:—
Bright Meteors.—Prof. P. G. TAIT, F.R.S.E. 305
Mr. Herbert Spencer and Physical Axioms.—Prof. F. GUTHRIE, LL.B. 305
ORGANISATION OF THE FRENCH METEOROLOGICAL SERVICE 306
NOTES 306
THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE . . 308
Inaugural Address by the President 309
Section A.—Opening Address by the President 319
Section C. do. do. do 324
Section D. do. do. do. 327
SCIENTIFIC SERIALS 330
SOCIETIES AND ACADEMIES 330
BOOKS RECEIVED 33

THURSDAY, AUGUST 27, 1874

FIFTH REPORT OF THE SCIENCE COMMISSION

THE Fifth Report of the Royal Commission on Scientific Instruction and the Advancement of Science, just issued, is a comparatively short one; but to many it will possess an unusual amount of interest, as showing how far private effort may be relied upon to supply the vast deficiency which at present exists in the means for affording a higher education accessible to all classes.

The Report is concerned with five institutions, each the result of private effort, and each having done much in its own way to raise the standard of the higher education, to place it within the reach of a wider circle, and to bring the physical and natural sciences to the front as indispensable branches of knowledge and an invaluable means of culture, without which all education must be radically incomplete. These institutions are—the two metropolitan Colleges (viz., University and King's Colleges), the Owens College, the Newcastle College of Physical Science, and the Catholic University of Ireland.

The Report gives an account of the origin and growth of each of these Colleges, founded on abundant data supplied by the authorities of the various institutions. Ample details are given as to the amount and sources of income of each of the five Colleges, the number and kinds of professorships, the income of each Chair, the number of students in each class during the last two years—in short, all information needed to form an opinion as to the kind and comprehensiveness of education which the Colleges aim to give, the means at their command to carry out their ideal aims, and the extent to which they have been successful.

The expenditure of University College, London, on capital account, for all purposes, up to the year 1870, amounted to 202,287*l.*, the whole having been defrayed out of the original share capital of the College, and out of the sums that have been either given or bequeathed to it for general purposes from time to time. In addition to the capital sum thus expended there are endowments arising out of various bequests which produced, in 1870, an annual income of 2,978*l.* Of this income, 2,276*l.* is appropriated to special purposes; no assistance has ever been received from any Government grant.

The School established in connection with the College is of unquestionable advantage to it, as a large and increasing proportion of well-prepared pupils pass from the former to the latter; and during the last few years the College has been slightly a gainer, in a pecuniary point of view, by the maintenance of the School. The scientific Chairs of the College are eleven in number. Of these eleven professorships, one only is endowed, Mr. T. J. Phillips Jodrell having lately presented to the College the sum of 7,500*l.* for a permanent endowment of the Chair of Physiology. With the exception of this recent benefaction, the College can hardly be said to possess any endowment whatever the revenue of which is properly applicable to the support of its Scientific Faculty. The Professor of Geology, however, receives 31*l.* per annum from the Goldsmid Fund.

The courses of study, as indicated in the programmes of the professorial lectures, appear to be carefully arranged with a view to the requirements both of elementary and of advanced students. Great importance is attached to the laboratory instruction in Physics, Chemistry, and Physiology. The College has but few scholarships or exhibitions, and of these, none are appropriated exclusively to scientific subjects.

The Report of the Council states that during the session 1873-74 the number of pupils was 1,542; of these, 893 were students in the College, and 649 pupils in the School. Of the students, 322 belonged to the Faculty of Medicine. In the Faculties of Arts and Laws and of Science there were 571. The fees received, exclusive of those for clinical instruction, amounted to 24,266*l.* 10*s.* 6*d.* The total payments out of these fees to the professors, teachers, and masters, amounted to 16,904*l.* 8*s.* 6*d.*, leaving 7,362*l.* 2*s.* for the College share of fees.

The evidence which has been laid before the Commission clearly shows that the usefulness of the College is greatly restricted by the insufficiency of funds. The difficulty is felt in two respects: first, in providing adequate payment for the professors and their assistants; and secondly, in providing laboratory accommodation upon a sufficient scale, together with the proper appliances for instruction and research. The Report gives a schedule of payments to the various scientific professors, followed by a schedule of the lectures given by each; and looked at merely from this point of view alone, the disproportion between the payment and the work done is very striking.

In the opinion of the secretary of the College, "the large deductions from the fees which the College is obliged to make in order to provide for the current expenses of the institution, have a twofold injurious effect. They materially diminish the remuneration of the professors, and so far tend to deprive the College of the services of able men, and by rendering it necessary to charge fees higher than might otherwise be requisite, they must have the indirect effect of keeping down the number of our students. The result is that our professors as a rule are very inadequately paid." The natural consequence of the inadequacy of the professorial stipends is, that in many cases the College has found it impossible to retain the services of some of its most distinguished professors. Some striking instances of very recent occurrence, which show the disadvantage at which the College is placed in this respect, are mentioned in the evidence.

The resources of the College have, moreover, been quite inadequate to provide suitable and sufficient laboratories, apparatus, and assistance for the practical departments of experimental science. The Council have done what they could with the means at their disposal, but these are so inadequate as seriously to cripple the efficiency of the scientific instruction given by the College. Proposals for the extension of the College buildings appear at various times to have come under the consideration of the Council, but no definite action has been taken with regard to them. One of the most important uses to which the additions would be put, were they made, would be laboratories for practical study and original research in connection with the various Science Chairs.

The history and constitution of King's College is in some respects similar to that of University College; by its original charter, however, dated 1828, it is intimately associated with the Church of England. It started at first and has all along had to struggle with even greater difficulties than University College. For new buildings and other purposes it has had to incur debt from time to time, more especially to meet the increased demands of physical science, for which more accommodation is urgently needed.

The expenditure of the capital funds of the College from its foundation up to the present time amounts to 180,421*l.* 5*s.* 9*d.*

The schedule of payments shows that, as in the case of University College, the teaching staff is very inadequately paid.

The evening classes at King's College have been eminently successful, and provide a fairly complete course of scientific instruction for persons who are unable to attend the day classes. They were attended in 1873 by as many as 550 students, the majority of whom attended more than one class; about 300 out of the 550 attending Science Classes. The financial relations of the School, which is in a flourishing condition, to the College are substantially the same as at University College.

The same complaint is made in the case of King's as in the case of University College; the chief impediment to its further success is "that it is so extremely poor." The various scientific departments of the College do not pay, and were it not for the theological and literary departments, the College, we fear, would have to shut its doors. The professors ought to get three-fourths of the fees, but often a percentage for college expenses has to be deducted from the small sums thus yielded.

We quote in full the recommendations of the Commission with reference to the two Metropolitan Colleges, recommendations which, if carried out, would undoubtedly increase the efficiency of these Colleges, and from which the country would reap a rich return.

> "After carefully reviewing the evidence laid before us with regard to University and King's Colleges, and especially taking into account the great public services which have been rendered by these two institutions to scientific education in the metropolis, we are of opinion that, subject to the reservations which we shall make hereafter, they have established a claim to the aid of Government which ought to be admitted. We think that such Government aid should be afforded, both in the form of a capital sum to enable the Colleges to extend their buildings where requisite, and to provide the additional appliances for teaching which the advance of scientific education has now rendered absolutely necessary; and also in the form of an annual grant in aid of the ordinary working expenses of the Colleges.
>
> "With regard to the grant of a capital sum, we are of opinion that it should be appropriated to definite objects such as those above referred to; and we further think that the amount of such grants should be dependent upon the amounts raised by subscription.
>
> "With regard to the annual grants in aid of the income of the Colleges, we think that they also should be appropriated to definite purposes, such, for instance, as the augmentation of the stipends of certain professorships, the payment of demonstrators and assistants, or payments in aid of the laboratory and establishment expenses. An account of the yearly expenditure of each institution receiving such assistance should be reported to Government. As the suspension or withdrawal of the annual grant would always remain in the power of Parliament, we do not think that it would be necessary or desirable to give the Crown a voice in the appointment of the professors, or any control over the management of the Colleges, other than such visitatorial jurisdiction as would be implied by an annual presentation of the accounts.
>
> "As we do not consider that a day school in the metropolis ought to receive pecuniary assistance from an institution which is itself in receipt of such assistance from Government, our recommendation of Government aid to University College is subject to the reservation that its financial arrangements shall be such as, while enabling the College to do full justice to the School, may prevent the School from becoming a charge upon the funds of the College on an average of years. Our recommendation is also subject to the reservation that the finances of the Hospital, and of the purely medical departments, shall be kept distinct from those of the College generally. Our inquiry has not extended to Medical Schools, and it is not within our province to make any recommendation with respect to Government aid to such schools, whether associated with scientific colleges or not. In the case of University College, where such an association exists, we think it expedient that the annual outlay on the purely medical department should be kept distinct, in order to enable the Government to consider separately the question of aid to the scientific department. At the same time, we do not think that there is any reason why the Boys' School and the Hospital should not continue, as at present, under the management and control of the Council of the College.
>
> "The same reservations apply to our recommendations with regard to King's College. Indeed, so far as King's College Hospital and the Medical School connected with it are concerned, the need of such a reservation is more obvious, because it is admitted that these institutions are a heavy burden upon the resources of the College.
>
> "With regard to King's College, we would further suggest that the College should apply for a new Charter, or for an Act of Parliament, with the view of cancelling the proprietary rights of its shareholders, and of abolishing all religious restrictions (so far as any such exist) on the selection of professors of science, and on the privileges extended to students of science. We consider that any grant of public money which may be made to King's College should be conditional on such a reconstitution of the College as should effect these objects. And we suggest that advantage might be taken of the opportunity thus afforded to introduce into the government of the College such other modifications as the experience of the persons concerned in its management may have shown to be desirable."

J. S. K.

(*To be continued.*)

THE INTERNATIONAL PREHISTORIC CONGRESS OF ANTHROPOLOGY AND ARCHÆOLOGY—STOCKHOLM MEETING

THIS Congress held its inaugural meeting on Aug. 7, and by acclamation elected Count Hamilton its president, and the gentlemen already mentioned in NATURE (vol. x. p. 307) its acting office-bearers.

There was no further business that day; but the 300 foreign members present (the whole Congress amounts to over 1,400) were hospitably entertained in the evening by the town of Stockholm at Hasselbacken, which is to Stockholm what Richmond is to London. There were music, supper, and fireworks; and during the evening, in reply to a well-worded toast of welcome from the Mayor, several good speeches were delivered by members of the council representing the different nations present.

On Saturday the real work of the Congress began, and the questions discussed were—What are the most ancient traces of man in Sweden? and Is it possible to indicate the routes, during antiquity, through which the commerce in yellow amber went?

Baron Kurck opened the discussion by stating that he believed that the most ancient traces of man were to be found in the southern parts of Sweden, and that during the Stone Age men had gradually and slowly travelled northwards, which he thought was sufficiently proved by the fact that the rudest constructed stone implements were found in the south, and that they became more and more mixed with polished ones as you proceeded in a northern direction. The question was entered into with liveleness, and, among others, three of our countrymen, Franks, Evans, and Howorth, took an active part and ably sustained the reputation of Anthropology among British *savans*.

At the Monday's sitting, when a point of great interest was discussed, namely, the characteristics of the polished stones in Sweden, and whether it was possible to attribute the antiquities of this age to one people or to the coexistence of several tribes inhabiting the different parts of Sweden, the King honoured the Congress with his presence. It would appear, too, that he was interested in the speeches, as on a subsequent day he not only himself returned, but brought the Queen with him. The discussion on that occasion was fortunately even more interesting than on the previous occasion, for it was on the Bronze Age, and what were the analogies in the manners and the industry of the Swedish people at that time when compared with those of the same period in the other countries of Europe: also on comparing the Bronze Age with those which preceded it. On Tuesday the Congress visited Upsala (the Oxford of Sweden), and were received and entertained by the professors and students in a most novel and interesting manner. They met us at the railway station, the students all with their white caps on, and carrying the twelve white silk banners, with the embroidered arms and devices of their respective provinces upon them, done in gold and silk thread in a manner which it would be hard to find female fingers at the present day, even when stimulated by Cupid's dart, capable or willing to execute. The choir of students, which I am told is the best in Europe, sang a song of welcome, and then marched before us to the principal points of interest in the town, several times giving us brilliant examples of their vocal powers, especially in the cathedral. Our visit to Upsala was, however, not one entirely for amusement, but for instruction, and a few miles from the town was one of the largest of the country's tumuli, opened for our inspection. It was nearly 40 ft. high, and composed chiefly of sand, covered over with grass, looking like a little hill, but one at whose height and steep sides you would look twice before attempting to ascend. In this were found human remains and the bones of animals (burned) supposed to have been offered in sacrifice. Fragments of gold and iron were also discovered, and a coin, all of which lead to the belief that this tumulus is not more ancient than the fourth century. Another excursion was made on Thursday to the Isle of Björko, where there is an ancient cemetery of 2,000 tumuli, each about 4 ft. or 5 ft. high, and from 12 ft. to 18 ft. in diameter. Within a couple of hundred yards from this is the site of the ancient town; nothing remains to tell of its site but the souvenirs which lie hid in its soil, which is called the "Black Earth," and is famous for its potatoes. Several trenches, 3 ft. deep and nearly 4 ft. wide, were run through the site of this ancient town, and several of the members of the Congress were fortunate enough to pick up articles of interest—fragments of very rude pottery, needles of bone, glass beads, fragments of iron, and an immense number of the bones of domestic animals, including those of the horse, ox, sheep, dog, cat, pig, as well as of birds. From the remains found here it appears this town must have existed at least up to the eighth century. Before the visit of the Congress to it were found several iron keys, fish-hooks, and pincers: also a whole necklace of coloured glass beads, chiefly white and red; a great many fragments of hair combs, some very well engraved, with crossing straight lines, circles, and dots. They were all formed of bone.

On the following day was discussed the question of how the age of Iron was characterised in Sweden, and an attempt was made to establish the relations at that period which existed between the Swedes and the more southern nations; but, just as on some of the other occasions, no definite conclusion was arrived at, and this arose from the great tendency members showed for discussing the details instead of keeping to the main subject. The last question considered was, what were the anatomical and ethnical characters of the prehistoric men in Sweden? This afforded a second opportunity to the Congress of hearing an interesting passage of arms between Messrs. Virchow and Quatrefages, very similar in substance to what we had from them in print the year after the Franco-German war. They agreed to differ then, and they agree to differ still. It was interesting, but not to the point. However, all ended amicably, and the seventh session of the International Prehistoric Anthropological and Archæological Congress may be said to have terminated by an evening party given by the King of Sweden to all its members at his country palace of Drottningholm, on Saturday, August 15, 1874. Her Majesty and the Queen Dowager were both present. This evening party will long remain in the memory of the members of the Congress as a pleasant tribute of royalty to the shrine of science, reflecting as it does as much credit on the intellectual acumen of him who gave it as honour on those who received it.

The next meeting of the International Prehistoric Anthropological and Archæological Congress will be held at Pesth in 1876.

GEORGE HARLEY

ARMSTRONG'S "ORGANIC CHEMISTRY"

Introduction to the Study of Organic Chemistry. The Chemistry of Carbon and its Compounds.[*] By Henry E. Armstrong, Ph.D., F.C.S. (London: Longmans and Co., 1874.)

TO write a good introduction to any subject is sufficiently difficult, but if the subject be developing very rapidly and undergoing very marked changes, as is the case with organic chemistry, obviously the difficulty of presenting such a subject to a student in a satisfactory manner is vastly increased. Dr. Armstrong has devoted himself heart and soul to his work: the requisite knowledge he evidently possesses, and he has shown good judgment in selecting from much new matter what to bring forward and what to withhold. Neither in arrangement nor in substance has he made direct use of previous treatises on the subject; he has written his own book on organic chemistry, and it certainly will prove to be a good and useful one.

No treatise of note on this subject had appeared of late years in our language, and this rapidly developing branch of science had outgrown the old form in which it had been cast. The change of name which has been suggested is really indicative of the change the science has undergone: formerly it was Organic Chemistry; now it is the Chemistry of the Carbon Compounds; in fact, formerly it was the properties of a few substances, the direct products from organised structures, which was studied, whereas now a very large portion of a treatise on organic chemistry is taken up with the exposition of the theoretical constitution of artificially prepared bodies. In few branches of science has theory been more useful and productive of more good than in this branch of chemistry; and certainly inorganic chemistry, although dealing with simpler bodies, owes much to lessons derived from the organic branch of the subject.

Dr. Armstrong has grouped his subjects in a simple, and, if in somewhat a summary, still in a philosophic way. He casts off and entirely ignores all bodies which at present refuse to fall into some established group. Thus, such bodies as the natural organic alkaloids, indigo, albumen, &c., find at present no place in his book; while we do not regret the exclusion of bodies of doubtful composition, unknown constitution, and but little special interest, still, to ignore the whole of the well-defined class of natural alkaloids was hardly necessary as a matter of principle, and certainly will prove inconvenient to the student.

Since this special property of carbon, this power which it has of combining with itself, appears capable of yielding an almost infinite number of compounds, the classification of this host of bodies becomes a matter of the first importance. So few were the number of organic bodies known only some forty years ago, that they could be classed according to their origin as vegetable or animal substances; afterwards there sprung up a multitude of bodies formed directly or indirectly from these, and we have the first indication of those series of bodies which are now so characteristic of organic chemistry. More or less of the old principle of grouping has lingered in the science until now, but in this book it gives way entirely to grouping dependent solely on constitution; some of the many series of organic bodies are now tolerably complete, and the discovery of new bodies, instead of as formerly tending to complicate the science, now tends to simplify it. In this arrangement of the compounds in series, Dr. Armstrong introduces a simplification which is important; he does away with the aromatic group of compounds as a distinct group, and merges them in the larger general groups. This aromatic group of compounds, as they have been designated, have undoubtedly very marked and specific properties, but Dr. Armstrong shall state for himself his reasons for giving up the exclusion of them from the general series to which they may be considered as belonging, and we think most chemists will be inclined to agree with him:—

"The division of carbon compounds into two great groups of fatty and aromatic substances, which has found favour of late years, has not been adopted. It appears to have arisen from the comparison of single substances, and cannot be sustained, I believe, if whole series are contrasted. It is now placed beyond doubt that in each homologous series of carbon compounds the properties (physical and chemical) of the successive terms undergo from first to last a progressive modification, and there is every reason to believe that in like manner the successive terms in each isologous series undergo a progressive modification. At present we are not acquainted with a single complete homologous or isologous series, so that it is difficult to draw conclusions; but to judge from the evidence at our disposal it appears highly probable that the modification in properties from term to term of each homologous and isologous series is of so gradual a character that continuity may be said to exist throughout. If so, it is as little possible to divide carbon compounds into two great groups as it is to draw a line which shall sharply divide so-called inorganic and organic compounds; that such a division appears possible at present is simply the consequence of the number of links which are still missing in the chain of facts."

While speaking of certain innovations which Dr. Armstrong has introduced into his book, the substitution of the term "unit weight" for combining or atomic weight should be noted: the term certainly has the advantage of being free from all theoretical significance; but if the term *atom* is objected to, the term *combining weight*, already in common use, would, we should have thought, so nearly have expressed Dr. Armstrong's meaning as to save the necessity of introducing a new term. The general arrangement of the book is clear and simple. The first chapter deals with the methods of organic analysis; and should any student be so unfortunate as not to have the opportunity of learning from experiment how organic bodies are analysed, certainly if he reads this chapter he will be well able to picture to himself the kind of way in which the determinations are made. The explanation of the use and meaning of formulæ naturally follow the determination of the data on which they rest. The following caution to students is not uncalled for, and cannot be too strongly impressed upon them. The author says, speaking of rational, constitutional, and structura formulæ: "The use of these terms seems to imply, however, that such formulæ express the constitution or structure of the bodies to which they refer; but we must guard ourselves most carefully against this impression, since, hypothesis aside, we possess no real knowledge as to the internal constitution of chemical compounds, or of the mode of arrangement of the atoms of which bodies are presumed to be made up; and although rational formulæ may represent the approximate constitution of chemical compounds, yet in the present state of our knowledge it is advisable to regard them simply as condensed symbolic expressions of the chemical nature and mode of formation of the compounds represented; they enable us, so to speak, to decipher at a glance the chemical history of compounds."

The second chapter is devoted to the classification of organic compounds, and Dr. Armstrong arranges them all under the following nine heads:—Hydrocarbons, Alcohols, Ethers, Aldehydes, Ketones, Acids, Anhydrides, Amines, and Organio-Metallic Bodies. To each class he devotes a few lines of explanation; in fact, the whole chapter is a general outline of what is to follow, and is very useful as giving a general and comprehensive view of the whole subject. The kind of action exerted by the most important reagents on organic bodies is next described, and will be useful to the student who already has some knowledge of the bodies acted on. After thus disposing of these introductory matters, the systematic study of the different classes of bodies above named is commenced and carried through, chapter by chapter, nearly in the above order, the study of Carbon itself forming the starting-point.

The book will certainly prove of great use in this country and do good service in extending a knowledge of organic chemistry. Students in general will hardly look upon it as an interesting text-book; long lists of rare substances, whose only real interest at present is in their constitution, cannot be made very attractive. The descriptions, however, of important methods of preparation and of purification of different bodies are very well given, and there is a reality and freshness about them which is not generally met with in systematic works on organic chemistry. Dr. Armstrong has evidently not been content to obtain all his information second hand.

The book will probably become the standard text-book on organic chemistry in this country, and in future editions probably will develop into a larger work; at present even it contains much detail, and is suited rather for the advanced student than for the mere beginner.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Mr. Herbert Spencer and Physical Axioms

IN my letter, published in NATURE, vol. x. p. 104, I asked the following question—Does Mr. Spencer regard the second law of motion as an "unconsciously-formed preconception," or as a "corollary of a preconception," or as a "consciously-formed hypothesis"?

This led to a correspondence with Mr. Spencer, which he has thought well to publish, with comments, as part of a pamphlet containing appendices to his former pamphlet entitled "Mr. Herbert Spencer and the British Quarterly Reviewer." Consequently, I should be glad if you would allow me space for a few final words to state what now appears to be the result of the controversy.

By the fuller explanation with which Mr. Spencer has favoured me, it has now been made clear that, on his theory of the evolution of physical axioms, the second law of motion is not itself a "preconception," but a "corollary of a preconception," that is, a truth implied in, but only evolved by conscious mental processes from, the preconception; though he afterwards somewhat qualifies this statement by admitting conscious *observation* to have its share in the result, when he says, "*Observation aids* in disentangling the truth that this relation between force and motion is more distinct where the actions are simplest—so leading to the intuition that the proportionality is absolute where the simplicity is absolute." I state this, in fairness to Mr. Spencer, because he lays stress on the distinction, and rightly so from the point of view of psychological theory; though as regards my argument that the second law of motion is not to be regarded as in any sense an *à priori* cognition, it is a side issue of no importance.

But with respect to the main issue, I have at length obtained a definite reply in a passage which I proceed to quote from Mr. Spencer's comments on my last letter to him. I had said—"Various hypotheses as to the relation between force and change of motion may be made, all consistent with the general preconception of the proportionality of cause and effect, and between which the mind alone is unable to decide, until it calls to its aid conscious observation or experiment." To which Mr. Spencer rejoins—(the italics are mine)—"This is perfectly true. I have said nothing to the contrary. My argument implies nothing to the contrary. *I am not concerned with the question how impressed force is to be measured, or how alteration of motion is to be measured* The second law of motion is a *purely abstract statement, and I hold it to be à priori only in its abstract form.* It asserts that the alteration of motion (a right mode of measurement being assumed) is proportional to the impressed force (a right mode of measurement being assumed). I do not affirm that we know, *à priori*, in what terms of space and time and mass change of motion is to be expressed. The law, as formulated, leaves this unspecified; and all I hold to be *à priori* is that which is alone stated in the law."

To the mathematician and physicist, comment on this is hardly necessary. I was right when I said, in a former note, that there is little left to argue about. The osteologist may doubtless for his own purposes speak of the skeleton of a horse as a horse, though the dry bones would be a sorry substitute for the living animal to a man who wanted it to do his work. And so, too, Mr. Spencer, as a psychologist, might (if it did not lead to that disastrous confusion which we have complained that his use or misuse of the terms of physical science does lead to) speak of the second law of motion "in its abstract form" as the second law of motion; but assuredly Newton, who had carefully defined quantity of motion and of motive force before enunciating his "Axiomata sive Leges Motûs," did not regard it as a "purely abstract statement;" and every mathematician and physicist, who has to any extent followed in Newton's steps, knows that all that gives life and force—that is, power to generate new results and to co-ordinate and explain the external phenomena with which physics is concerned—to this or any other physical axiom is not its *à priori* basis or abstract form, but that element in it which has been derived from conscious observation or experiment.

The upshot of the whole controversy, then, is that the physical axioms of Mr. Spencer are not the living truths which form the basis of the physical sciences, but the bare abstract forms in which those truths may conveniently—possibly Mr. Spencer would say *must*—be expressed. I trust that the value of this result, to the readers of Mr. Spencer's first principles, may be some atonement for the space and time which the controversy has occupied.

ROBERT B. HAYWARD

Harrow

Darwin on "The Origination of Life"

WE are constantly meeting with an objection to Mr. Darwin's writings, urged alike by friends and foes, on the score of his not having published his views concerning the origin of life. As this objection refers to a matter of literary taste rather than to anything of substantial importance, in ordinary cases it is best met by silence; but when a President of the British Association gives it a prominent position in his inaugural address, it is time that a dissentient view should be raised.

Towards the close of his discourse, Dr. Tyndall observes:—"The *origination* of life is a point lightly touched upon, if at all, by Mr. Darwin and Mr. Spencer. Diminishing gradually the number of progenitors, Mr. Darwin comes at length to one 'primordial form;' but he does not say, as far as I remember, how he supposes this form to have been introduced. He quotes with satisfaction the words of a celebrated author and divine who had 'gradually learnt to see that it is just as noble a conception of the Deity to believe He created a few original forms capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws.' What Mr. Darwin thinks of this view of the introduction of life I do not know. Whether he does or does not introduce his 'primordial form' by a creative act, I do not know. But the question will inevitably be asked, 'How came the form there?' . . . . We need clearness and thoroughness here," &c. Now, I submit that although this is a question which must "inevitably be asked," it is nevertheless a question with which Mr. Darwin has nothing whatever to do. The problem concerning the origin of life is as distinct from that concerning the origin of species, as any two problems can well be; and it does not devolve upon a writer to speculate upon the one, merely because he has solved the other. Those who have taken the greatest interest in Mr. Darwin's illustrious career cannot have failed to appreciate the admirable forbearance he has always displayed in not allowing himself to digress into collateral topics, however great the temptation to digress may be. All his vast and numerous conquests of thought have been achieved by a rigid adherence to the philosophy of fact; there is a grand consistency in the maintaining of a method, according to which pure speculation is nowhere permitted to assert itself, excepting in so far as it is absolutely necessary. Surely it would be a deplorable thing were "the epoch-making book" allowed to present a gratuitous deviation from this method, merely in order to plunge into a sea of *à priori* conceptions where inductive verification is as yet impossible. The passage quoted by Prof. Tyndall is adduced by Mr. Darwin only in order to show that *so far as the doctrine of the transmutation of species is concerned*, the evolution theory supplies us with "just as noble a conception of the Deity" as does the theory of special creation. Regarding the more ultimate question, everyone must say with Dr. Tyndall, "What Mr. Darwin thinks of the introduction of life I do not know;" and this, I take it, is just the condition in which the author of the "Origin of Species" should allow his opinions to take their place in history. In short, those who censure Mr. Darwin for his praiseworthy reticence regarding "the far higher problem of the essence or origin of life, upon which science as yet throws no light," * would do well to consider the beautiful example of scientific caution that is afforded by the manner in which this very subject is treated of in the concluding pages of the last edition of the "Origin;" and I am sure that I am only expressing the opinion of the majority of Mr. Darwin's admirers when I say, that whatever our ontological views may happen to be, we all unite in sincerely hoping that, in subsequent editions, he will not spoil the splendour of his finished work by indulging in speculations as foreign to his subject as they must be unprofitable in themselves.

Aug. 21 A DISCIPLE OF DARWIN.

Meteors

ON referring to my record of meteors for the 8th inst., I find two meteors nearly at the times mentioned by Prof. Tait (vol. x. p. 305), viz., 10.33 and 10.53. That at 10.33 was, from its position as seen here, unquestionably *not* identical with the one he saw. That at 10.53 may possibly be the same, if by Monoceros Prof. Tait means the constellation commonly marked at Equuleus. If such is the case, a calculation, rough as the data necessitates, would give for the meteor's height at the beginning 144 miles; at the end, 87 miles.

I have of course had to assume a path for the northern station, but as the radiant point was indicated, and one point of the meteor's course, I had not much choice in the matter.

Birmingham, Aug. 24 THOS. H. WALLER

ANOTHER NEW COMET

THE following communication, dated Mr. Bishop's Observatory, Twickenham, Aug. 20, has been sent to the *Times* by Mr. J. R. Hind, F.R.S.:—

"We have received to-day from M. Stephan, director of the Observatory at Marseilles, telegraphic notice of the discovery of a comet this morning by M. Coggia, in the constellation Taurus, the position of which is thus given:—

"August 19, at 14h. 33min. mean time at Marseilles.—Right ascension, 59° 29′; Polar distance, 62° 55′. Motion towards the south-east. The comet is faint.

"The comet discovered at the same observatory by M. Borrelly, on the 25th of July, I observed here last night as follows:—

"August 19, at 9h. 27min. 38sec. mean time at Twickenham.—Right ascension, 13h. 32min. 7·58sec.; Polar distance, 17° 21′ 42·3″.

"It does not appear, as yet, to have materially decreased in brightness."

THE BRITISH ASSOCIATION AT BELFAST

BELFAST, *Tuesday Night*.

BELFAST is quite the centre of Irish industry, and one of the most progressive towns in the kingdom. People are living who remember it with less than 20,000 inhabitants; now it has near 200,000. As a proof of industry and thrift, it offers a good example to the rest of Ireland. The Association has not met under very favourable circumstances, for unfortunately at this moment no less than 20,000 men in the town are on strike, and somewhat less than 15,000*l.* a week is withdrawn from circulation. A smaller town with a less elastic population would be paralysed, and the influence of the strike is sufficiently felt as it is. The population of the town is very mixed; it is not true Irish. Belfast is less Irish either than Dublin, Cork, Galway, Derry, or Limerick. There is a large leaven of Scotch and Scoto-Irish, who have indeed the merit of a thrifty nature, but who lack many of the good qualities of the Irish; among others, their hospitality. The thrift of these people has caused the hotel and lodging arrangements to be carried out in an abominable manner. We have been shamefully fleeced. One hotel charges a sovereign a night for a bedroom, others half as much; in any case, members of the Association are charged at least double the ordinary prices. In final despair we were driven to inquire at a small coffee-shop whether they had a room; the people replied that they had; but that if we were a member of the Association we must pay ten shillings a night, the ordinary price in that house being about two shillings. When people travel from a distance, and sacrifice time, money, and rest, to do the work of the Association, and not as pleasure seekers, it is rather hard to be swindled because you happen to be a member of the Association.

The Sections have been well filled, and have had plenty of pabulum in the form of papers and verbal communications. Section A has been divided into two Departments, and it is probable that one or two of the Sections will have to sit on Wednesday. The addresses were quite up to the average. Among the more interesting papers were those of Mr. Huggins, On the Spectrum of Coggia's Comet; Prof. Wiedemann, On the Magnetisation of Chemical Compounds; Dr. Carpenter, On the *Challenger* Deep-sea Dredgings; and Mr. E. J. Harland, On a Screw-lowering Apparatus for Ships. The expected fight about the *Eozoön Canadense* did not come off. The specimen and apparatus room is well filled. Among the more interesting objects we observe Prof. Barrett's apparatus for showing the elongation of iron, cobalt, and nickel by magnetisation, Mr. Braham's heliostat and ruled glass used in experiments on light, and Mr. Roberts' illustrations of columnar structure, artificially produced. The Thursday *soirée*, on the other hand, was singularly devoid of exhibitions of any kind, and the Ulster Hall was extremely crowded, both causes tending to make the evening drag rather heavily. There were several excursions on Saturday, and there are many prepared for Thursday, the principal being to the Giants' Causeway. The Mayor, who has throughout been very active in forwarding the interests of the Association, has issued invitations for a trip round the coast on Thursday, for which purpose he has engaged one of the fine Fleetwood mail steamers.

The Association meets next year at Bristol, Sir John Hawkshaw, C.E., F.R.S., being President-elect; Glasgow is to be the place of meeting in 1876, an influential deputation having attended the Association to urge upon it the claims of that city to the honour of its presence. Plymouth will probably be the rendezvous for 1877.

The following is the financial statement of the Association for the past year:—

---

* "Origin of Species," p. 421, 1874.

RECEIPTS.

To balance brought from last account				£924	15	10
Life Compositions at Bradford Meeting, and since				358	0	0
Annual Subscriptions do. do.				646	0	0
Associates' Tickets do. do. ...				796	0	0
Ladies' Tickets do. do. ...				601	0	0
Dividends on Stock				237	10	0
Sale of Publications				21	18	1
Balance of Grant made at Brighton to the Sewage Committee				26	8	7
				£3,611	12	6

PAYMENTS.

Expenses of Bradford Meeting, also sundry Printing, Binding, Advertising, and Incidental Expenses ...				£373	8	4
Printing, Engraving, &c., Report of 42nd Meeting (vol. 41), Brighton				696	13	10
Ditto on Account of Report of 43rd Meeting (vol. 42), Bradford				58	13	5
Salaries (one year)				462	6	0
Rent and Office Expenses (Albemarle Street) ..				104	5	0
Grants made at Bradford Meeting, viz. :—						
Zoological Record				100	0	0
Chemistry Record				100	0	0
Printing Mathematical Tables				100	0	0
For Committee on—						
Elliptic Functions				100	0	0
Lightning Conductors				10	0	0
Thermal Conductivity of Rocks				10	0	0
Anthropological Instructions, &c... ...				50	0	0
Kent's Cavern Explorations				150	0	0
Luminous Meteors				30	0	0
Intestinal Secretions				15	0	0
British Rainfall				100	0	0
Essential Oils				10	0	0
Sub-Wealden Exploration				25	0	0
Settle Cave Exploration				50	0	0
Mauritius Meteorological Researches ...				100	0	0
Magnetisation of Iron				20	0	0
Marine Organisms				30	0	0
Fossils, North-west of Scotland				2	10	0
Physiological Action of Light				20	0	0
Trades' Unions				25	0	0
Mountain Limestone Corals				25	0	0
Erratic Blocks				10	0	0
Dredging, Durham and Yorkshire ..				28	5	0
High Temperature of Bodies .. .				30	0	0
Siemens's Pyrometer				3	6	0
Labyrinthodonts of Coal-Measures				7	15	0
Widow of W. J. Askham				50	0	0
Aug. 19, Balance at Bank ..	£698	10	5			
Ditto in hands of General Treasurer	15	19	6			
				714	9	11
				£3,611	12	6

SECTION B

CHEMICAL SCIENCE.

OPENING ADDRESS BY THE PRESIDENT, PROF. A. CRUM BROWN, M.D., F.R.S.E., F.C.S.

ONE hundred years have elapsed since the discovery of oxygen by Priestley. Perhaps we should say rediscovery, for there is no doubt that about one hundred years earlier Mayow prepared from nitre nearly pure oxygen, and observed and recorded some of its most marked properties. Mayow's discovery, however, led to nothing, while Priestley's was the most important step in that reconstruction of speculative chemistry which was commenc-d by Black and carried on with surprising energy and thoroughness by Lavoisier and his associates. I shall not detain you by enumerating the ways in which this discovery has affected chemistry both practical and speculative. The pre-eminent position to which oxygen was at once elevated, and which it so long retained, makes this altogether unnecessary. I wish, however, to point out one character of the phlogistic controversy which sharply distinguishes it from many others. The truth represented by the theory of Phlogiston was not recognised with sufficient distinctness by the supporters of that theory to give them any chance of success in opposition to a band of devoted adherents of a view which was clearly understood by all. The phlogistists were completed defeated, and the theory ceased to exist. It has been left for chemical antiquaries to pick out, with difficulty and uncertainty, a meaning from the ruins.

I have mentioned this character because I wish to draw your attention to another more recent controversy, the result of which was very different.

The questions as to chemical constitution raised about forty years ago by Dumas and the new French school, in opposition to Berzelius, may now be said to be practically settled. The great majority of chemists are agreed as to what is to be understood by chemical constitution, and also as to the nature and amount of evidence required in order to determine the constitution of a substance. How has this agreement been produced? Some historical writers seem to wish us to believe that it is the result of the triumph of the ideas of Dumas, Gerhardt, and Laurent, and the defeat of the dualistic radical theory of Berzelius; that the arguments of Berzelius and his followers were only useful as giving occasion for a more full and convincing proof of the unitary substitution theory than would otherwise have been called for; that, in fact, the adherents of dualism played the part (not unfrequently supposed to be that of the Conservative party in politics) of checking and criticising the successive developments of truth, and thus allowing them time to ripen.

In opposition to the view thus broadly stated, I would place another, and for the sake of contrast shall state it also in perhaps too broad a form:—That the two theories, the dualistic radical theory and the unitary substitution theory, were both true and both imperfect, that they underwent gradual development, scarcely influenced by each other, until they have come to be almost identical in reference to points where they at one time seemed most opposed.

I have said that the development of the one theory was scarcely influenced by that of the other. Of course the *facts* discovered by both parties were common property, and the development of both theories depended upon the discovery of these facts; but the explanations of facts and the reasoning from them given by each party seemed to the other scarcely worthy of serious consideration, and were treated as matter of ridicule. And the habit of mind created by this mode of viewing the opposed theory rendered it difficult for those who were engaged in the controversy on either side to see how nearly the two theories have now come to coincidence. Their language still remains different; but as the facts are the same for both, it is not difficult for a neutral critic to translate from the one to the other; and if we do so we shall see that there is much real agreement between the two modes of representing chemical ideas, historically derived, the one from Berzelius, the other from Dumas, Laurent, and Gerhardt.

In both, chemical constitution is regarded as *the order in which the constituents are united in the compound;* and the same fundamental notion is indicated in the one by reference to proximate constituents, in the other by the concatenation of atoms. To show that this is so, and that the fundamental notion can be arrived at from the dualistic as well as from the unitary starting point, I shall cite an illustrative case. Every student of chemical history will remember the view of the constitution of trichloracetic acid propounded by Berzelius, and afterwards supplemented by a similar view of the constitution of acetic acid and an explanation of the likeness of some of the properties of these two substances. This has sometimes been spoken of as a subterfuge of a not very creditable kind, by means of which Berzelius apparently saved his consistency while really yielding to the arguments of his opponents. But if, instead of looking at it in the light of the substitution controversy, we consider it in itself as a contribution to speculative chemistry, we at once recognise in it a statement, in Berzelian language, of the views we now hold as to the constitution of these acids. The view was that acetic acid is a compound of oxalic acid and methyl, trichloracetic acid a compound of oxalic acid and the sesquichloride of carbon. They differ considerably from each other, because the "copulæ" (methyl and sesquichloride of carbon respectively) are different; but their resemblance is strongly marked, because they contain the same active constituent, oxalic acid; and most of the prominent characters of the substances depend upon it, and not upon the copulæ Let us first free this statement from what we may call archaisms of language. It will then assume something like the following form:—The carbon in acetic acid is equally divided between two proximate constituents, one of which is an oxide, the other a hydride of carbon. Trichloracetic acid similarly contains an oxide and a chloride of carbon, between which the carbon is equally divided. The oxide is the same in both acids, and is that oxide which occurs in oxalic acid. The hydride and the chloride have the composition of the substances, the formulæ of which are C_2H_6 and C_2Cl_6 respectively. Oxalic acid undergoes chemical change much more readily than the corresponding hydride or chloride; and therefore the chemical character of acetic and of trichloracetic acids depends much more on the oxidised than on the other constituent, and they thus have a marked resemblance. The oxidised constituent is united to the other in a manner different from that in which oxalic acid is united to bases in the oxalates, inasmuch as, while the basic water of hydrated oxalic acid is displaced when oxalic acid unites with a base, in hydrated acetic and trichloracetic acids there is the same proportion between the basic water and the oxidised carbon as there is in oxalic acid.

Now, has not this a great resemblance to the view entertained by most modern chemists, that acetic acid is a compound of the radical carboxyl (half a molecule of oxalic acid) and the radical methyl (half a molecule of methyl gas), that trichloracetic acid similarly contains the same radical carboxyl and the radical CCl_3, and that the prominent chemical properties of these bodies depend upon their containing carboxyl, and that they therefore resemble each other?

The modern view contains nothing inconsistent with that of Berzelius; but it no doubt contains something more: it contains an explanation of the difference between the manner in which carboxyl is united to methyl in acetic acid, and the manner in which oxalic acid is united to bases in the oxalates. But it will surely be admitted that Berzelius was here far ahead of his opponents—so far ahead, that they altogether failed to see his meaning, and looked upon his argument as a clumsy device.

The treatment by Berzelius of the constitution of the sulpho-acids, furnishes a precisely similar case. These are now regarded as compounds of the radical SO_2OH (which we may call sulphoxyl). This radical is half a molecule of hyposulphuric acid; and Berzelius considered them coupled compounds of hyposulphuric acid, adopting at once the view first brought forward by Kolbe in his classical memoir on the sulphite of perchloride of carbon and the acids derived from it.

I might pursue the history of the carbon- and sulpho-acids further, and trace the development of the theory of their constitution through the discoveries of Kolbe, and his beautiful application to the cases of carbon and sulphur of Frankland's far-sighted speculation on the constitution of the organo-metallic bodies, pointing out the relation of Kolbe's views of the constitution of acids, alcohols, aldehydes, and ketones, to the Berzelian theory on the one hand, and to the opinions of modern chemists on the other; but the greater part of such an historical sketch has been given very recently by Kolbe himself in the *Journal fur praktische Chemie*, and I may therefore omit it.

It would be easy to bring forward cases to show that our present views can be directly derived from the substitution theory and the types of Dumas and Gerhardt, through the complications of multiple and mixed types, and the labyrinthine formulæ to which these gave rise, to the wonderfully simple and comprehensive system of Kekulé; but that is unnecessary, as this development has been fully and ably described by more than one thoroughly competent writer.

We have been discussing a case in which Berzelius was right in considering a compound of carbon, oxygen, and chlorine as composed of two parts—an oxide and a chloride of carbon. It is only just that we should only take some notice of cases, at first sight similar, in which modern chemists would be inclined to think that he was wrong. This is the more necessary, as an examination of these cases will enable us to see what was the really valuable contribution made to speculative chemistry by the substitution theory.

Compounds containing three elements were formulated in two different ways by Berzelius:—

1. One of the elements was represented as combined with a radical composed of the other two, as—hydrocyanic acid, $H_2 \cdot C_2N_2$; ether, $C_4H_{10} \cdot O$.

2. The ternary compound was represented as composed of two binary compounds, having one element common, as—caustic potash, KO, H_2O; chromochloric acid, $2CrO_3, CrCl_6$.

Phosgene gas was at first formulated in the former of these ways as CO, Cl_2; but latterly he was forced, in consistency, to give up all radicals containing oxygen or other strongly electro-negative element,* and to write the formula of phosgene gas CO_2, CCl_4. Similarly, in every case where a positive element or radical is combined with two negative elements or radicals, he represented the compound as composed of two binary compounds, thus—chloride of acetyl, $2C_4H_3O_3, C_4H_3Cl_3$, as a compound of acetic acid and the corresponding terchloride.

This was in perfect consistency with the mode in which tertiary compounds containing one negative and two positive elements or radicals were formulated, as caustic potash, KO, H_2O, sulphate of copper, CuO, SO_3, &c.; but it lacks the practical justification which can be given for the formula C_2H_6, C_2O_3 for acetic acid; for phosgene acts readily on water, forming carbonic and hydrochloric acids, an action which does not take place with perchloride of carbon; and it is not easy to see why the latter substance should be more readily attacked by water when combined with carbonic acid than when free. This difference did not escape the attention of Berzelius, and led him to distinguish two modes of chemical union: (1) where the constituents were held together by the electro-chemical force, and wholly or partially neutralised each other, as in the oxygen and sulphur salts; and (2) where a so-called "copula" was attached by an unknown force to a substance without greatly modifying its chemical activity. The distinction seems arbitrary; but it was not, as is usually supposed, a mere artificial bulwark to protect the electro-chemical theory; it has a real and very important meaning, a meaning which the development of the substitution theory enables us to explain.

The phenomena of electrolysis, upon which the Berzelian system is based, bring forward into great prominence *one* of the chemical units, viz. the *equivalent*; and the pre-eminent position of oxygen as the most electro-negative element made it most natural to select the atom of oxygen as the standard of equivalence, so that an equivalent of any element or radical was defined as that quantity of it which is equivalent to one atom of oxygen. Gay-Lussac's law of gaseous volumes, which was adopted by Berzelius, and which, by a curious accident, happens to be true for all elements gaseous at ordinary temperatures, led to the formulæ H_2 and Cl_2 for the *equivalents* of hydrogen and chlorine; but although these formulæ explicitly indicate the divisibility of the equivalents of these elements, this divisibility was not recognised, and integral numbers of equivalents were alone tolerated. Thus hydrochloric acid was written H_2Cl_2, ammonia N_2H_6, &c., and the etymological meaning of the word atom was soon lost. The use of barred letters to indicate two atoms or one equivalent of such elements as hydrogen and chlorine further contributed to hide the important fact of their divisibility.

The first great result of the substitution theory was to change the unit of equivalence, and to take as the standard the atom of hydrogen or of chlorine instead of that of oxygen; and although it would be most unjust to forget the services of Dumas, Gerhardt, Laurent, and Odling in this matter, the credit of removing the bars from H, Cl, and their comrades, and allowing the hitherto chained partners to walk at liberty, undoubtedly belongs mainly to our distinguished colleague and master, Prof. Williamson.

The establishment of the water type, or (to put it in another form) the proof that the atom of oxygen contains two units of oxygen, inseparably united but capable of separate action, led the way to the explanation of all the difficulties which beset the theory of radicals and copulæ. It at once explained how two oxides or two sulphides unite together;* and the idea of "polybasic," or, as we should now say, polyad atoms and radicals, was soon used to explain the existence of polybasic acids, double salts, acichlorides, and many other kinds of ternary compounds.

But a fact does not cease to exist because it is explained. Quicklime and water unite together, although we can now explain how they do so; and a useful purpose may still be served by the enumeration, as in the old dualistic formulæ, of the pairs of united equivalents. Although some of these equivalents belong to the same atoms, it is nevertheless true that they are united in pairs. Caustic potash might thus be formulated, $KO\frac{1}{2}, HO\frac{1}{2}$ or $\frac{1}{2}(K_2O, H_2O)$; phosgene gas, $\frac{1}{2}(CO_2, CCl_4)$; and chlorochromic acid, $\frac{1}{2}(2CrO_3, CrCl_6)$. These formulæ are not so well suited for general use as those now current; but the consideration of them as accurate representations of facts may enable us to see that the copulæ of Berzelius had a real and valuable meaning. Take, for instance, the formula of acetic acid, $H_3C—CO—OH$, or $\frac{1}{2}CH_4, \frac{1}{2}CO_2, \frac{1}{2}H_2O, \frac{1}{2}C_2$; it is this last term which indicates the coupled character of the compound. If we look upon acetic acid as a compound of carbon, it is a coupled compound because all the equivalents of carbon in it do not belong to the same atom, and the two atoms of carbon are directly united together, and replacement of the equivalents united to one of these atoms does not very greatly affect the function or chemical character of the equivalents united to the other.

---

* In 1838 Berzelius was inclined to regard C_2O_2, to which he gave the name "oxatyl," as the radical of oxalic acid and oxamide.

* It does not explain the existence of double chlorides, bromides, &c. These compounds, apparently so similar to the double oxides and sulphides, are still unexplained.

I have perhaps spent too much of your time upon these historical questions. Let us now shortly consider what is the present state of our knowledge as to chemical constitution. This I have already defined as the order in which the constituents are united in the compound. We may indeed use metaphorical language, and speak of the relative position of atoms, perhaps deluding ourselves into the notion that such language is more than metaphorical; but the phenomena of combination and decomposition, although we cannot doubt that they depend solely upon the relative position and dynamical relations of the atoms, are not alone sufficient to prove even that atoms exist. Our knowledge of the intimate structure of matter comes from another source—from the study of the properties rather than of the changes of substances, and of the transformations of energy which accompany the transformations of matter.

This is strictly a branch of chemistry: the aim of chemistry is to connect the properties of substances and the changes they undergo with their composition, taking this word in its widest sense; and we must not allow our friends in Section A to cut our science in two and appropriate the half of it. We all frankly admit that chemistry is a branch of physics; but it is so as a whole—no section of it is more purely physical than all the rest. To accept a narrower definition of chemistry is to reduce ourselves to the position which the collector occupies among naturalists; it is to admit that it is our business to provide part of the materials out of which a science in which we have no share may be constructed by others. But we need not fear that this so-called physical side of chemistry will ever be divorced from the study of chemical change. The names of Faraday and Graham among those who have left us, of Andrews among those who are still at work, are sufficient proof of this; and a study of their researches will conclusively show that great results can be looked for in this direction only from a physicist who is also a chemist.

There are three special directions in which such investigations have already influenced chemical theory:—1. *Electrolysis*, which has confirmed the equivalent as a chemical unit, has proved that equivalents unite in pairs, thus forming the basis of electro-chemical theory, and has shown us how to estimate the amount of energy involved in the union of a given pair of equivalents. 2. *Vapour-density*, from which Avogadro inferred the law of molecular volumes (since proved by Clerk-Maxwell), which has given us the molecule as a chemical unit, and formed the basis of the unitary theory. 3. *Specific heat*, from which Dulong and Petit inferred their empirical law, which gives us the most satisfactory physical definition of the atom as a chemical unit.

We naturally turn to the future, and try to guess whence the next great revolution will come. For although periods of quiet have their use, as affording time for filling up the blank schedules furnished by the last speculative change, such periods have seldom been long, and each has been shorter than its predecessor.

But it is impossible to make a certain forecast: looking back, we see a logical sequence in the history of chemical speculation; and no doubt the next step will appear. after it has been taken, to follow as naturally from the present position. One thing we can distinctly see—we are struggling towards a theory of chemistry. Such a theory we do not possess. What we are sometimes pleased to dignify with that name is a collection of generalisations of various degrees of imperfection. We cannot attain to a real theory of chemistry until we are able to connect the science by some hypothesis with the general theory of dynamics. No attempt of this kind has hitherto been made; and it is difficult to see how any such attempt can be made until we know something in reference to the absolute size, mass, and shape of molecules and atoms, the position of the atoms in the molecule, and the nature of the forces acting upon them. Whence can we look for such knowledge?

The phenomena of gaseous diffusion, of gaseous friction, and of the propagation of heat through gases, have already given us an approximation to the size and mass of the molecules of gases. It is not unreasonable to suppose that a comparative study of the specific heat of gases and vapours may lead to some approximate knowledge as to the shape of their molecules; and a comparison of such approximate results with the chemical constitution of the substances may lead to an hypothesis which will lay the foundation of a real theory of chemistry.

Chemistry will then become a branch of applied mathematics; but it will not cease to be an experimental science. Mathematics may enable us retrospectively to justify results obtained by experiment, may point out useful lines of research, and even sometimes predict entirely novel discoveries, but will not revolutionise our laboratories. Mathematical will not replace Chemical analysis.

We do not know when the change will take place, or whether it will be gradual or sudden; but no one who believes in the progress of human knowledge and in the consistency of Nature can doubt that ultimately the theory of Chemistry and of all other physical sciences will be absorbed into the one theory of Dynamics.

SECTION E

GEOGRAPHY

OPENING ADDRESS BY THE PRESIDENT, MAJOR WILSON, R.E.

THE President of the Royal Geographical Society has so recently delivered his anniversary address, that if I were to attempt to trace the progress of geographical discovery during the period that has elapsed since the meeting of the British Association at Bradford in September last, I could scarcely avoid repeating much that has already been said in far abler terms than I have it within my power to command. Still there are, at the present moment, certain subjects of such very general interest and of so much importance that they cannot well be passed over in any address to the Geographical Section of the British Association.

It has, I believe, been usual in the addresses to this Section to select some special subject for remark, and I will therefore, if you will allow me, before alluding to the geographical achievements of the year, draw your attention to the influence which the physical features of the earth's crust have on the course of military operations; to the consequent importance of the study of physical geography to all those who have to plan or take part in a campaign; and to the contributions to geographical science that are due, directly or indirectly, to war, and the necessity of preparing for war. To show how varied are the conditions under which war has to be carried on, and how much its successful issue may depend on a previous careful study of the physical character of the country in which it is waged, it is only necessary to remind you of the recent operations on the Gold Coast, brought to a successful issue in an unhealthy climate, and in the heart of a dense tropical forest, where an impenetrable undergrowth, pestilential swamps, and deep rivers obstructed the march of the troops; of the Abyssinian expedition, landing on the heated shores of the Red Sea, and thence, after climbing to the lofty frozen highlands of Abyssinia, working its way over stupendous ravines to the all but inaccessible rock, crowned by the fortress of Magdala; of the march of the Russian columns across the steppes and deserts of Central Asia to the Khivan oasis, one month wearily plodding through deep snow, the next sinking down in the burning sand, and saved from the most terrible of disasters by the timely discovery of a well; and, lastly, of the great struggle nearer home, the last echoes of which have hardly yet passed away, when the wave of German conquest, rolling over the Vosges and the Moselle, swept over the various provinces of France. The influence of the earth's crust on war may be regarded as twofold: first, that which it exerts on the general conduct of a campaign; and, second, that which it exerts on the disposition and movement of troops on the field of battle. Military geography treats of the one, military topography of the other; and it is well to keep this broad distinction in view, for, as with strategy and tactics, they stand in such close relation to each other that it is not always easy to say where geography ends and topography begins. Of special importance in the first case are great inequalities or obstacles that confine or obstruct the movement of large bodies of troops, and those features that retard or accelerate their march. The climate of the theatre of war must always have an important influence on military operations, and should be the subject of careful study. Our own experience in the Crimea shows how much suffering may be caused by want of forethought in this respect. General Verevkin's remarkable march of more than a thousand miles, from Orenburg to Khiva, with the thermometer ranging from 24° below zero to 100°, without the loss of a man, shows what may be accomplished with due preparation. Nor should the geological structure of a country be overlooked in its influence on the varied forms which the earth's crust assumes, on the presence or otherwise of water, on the supply of metal for repairing roads, and, if we may trust somewhat similar appearances on the Gold Coast, at Hong Kong, and in the Seychelles, on the healthiness or unhealthiness of the climate. It is scarcely necessary to remind you that though mountain ranges and rivers materially affect the operations of war, they are by no means insurmountable obstacles. The Alps have been repeatedly crossed since the days of Hannibal; Wellington crossed the Pyrenees in spite of the opposition of Soult; Diebitsch the Balkan, though defended by the Turks; and Pollock forced his way through the dreaded Khyber; whilst there is hardly a river in the length and breadth of Europe that has not been crossed, even when the passage has been ably disputed. This is hardly the place to discuss the minuter details of military geography and topography: they will be found in the works specially devoted to the subject.

Queen Elizabeth's Minister was right when he said that "Knowledge is power;" and a knowledge of the physical features of a country, combined with a just appreciation of their influence on military operations, is a very great power in war. A commander entering upon a campaign without such knowledge may be likened to a man groping in darkness; with it he may act with a boldness and decision that will often ensure success. It was this class of knowledge, possessed in the highest degree by all great commanders, that enabled Jomini to foretell the collision of the French and Prussian armies at Jena in 1807, and in later years enabled a Prussian officer, when told that MacMahon had marched northwards from Chalons, to point unerringly to Sedan as the place where the decisive battle would be fought. As, then, all military operations must be based on a knowledge of the country in which they are to be carried on, it should never be forgotten that every country contiguous to our own—and the ocean brings us into contact with almost every country in the world—may be a possible theatre of war, and that it is equally the duty and policy of a good Government to obtain all possible information respecting it. Is it with much satisfaction that we can turn to the efforts made by this country to acquire that geographical knowledge which may be of so much importance in time of need? Though we had for years military establishments on the Gold Coast, and though we had more than once been engaged in hostilities with the Ashantees, and might reasonably have expected to be so again, no attempt appears to have been made to obtain information about the country north of the Prah, or even of the so-called protected territories. The result was that when the recent expedition was organised, the Government had to depend chiefly on the works of Bowdich, Dupuis, and Hutton, written some fifty years ago, and on a rough itinerary of the route afterwards followed by the troops, for their information relating to the country and its inhabitants. What advantage has been taken of the presence of the officers who have been in Persia during the last ten years to increase our knowledge of that country—knowledge which would be very useful at present in the unsettled state of the boundary questions on the northern and north-eastern frontiers? How little has been added to our knowledge of Afghanistan since the war in 1842? and what part did India take in Trans-Himalayan exploration before Messrs. Shaw and Hayward led the way to Yarkand and Kashgar? It was with feelings of no slight satisfaction that many of us heard last year that the policy of isolation and seclusion which India appears to have adopted as the last soldier of Pollock's relieving force recrossed the Indus was at last to be broken, and that an expedition well found in every respect was to be sent to Kashgar. It seemed an awakening from the long slumber of the last thirty years, during which we were content to stay at home in inglorious ease, resting under the shadow of the great mountain ranges of Northern India, whilst we sent out mirzas and pundits to gather the rich store of laurels that hung almost within our grasp. Far be it from me to depreciate the valuable services of those gentlemen,—services frequently performed at great personal risk and discomfort; but who can compare the results they obtained with those that would have been brought back by English officers, or by travellers, such as Mr. Shaw, Mr. Ney Elias, and others? It has been said that if officers travelled in countries where Government could no longer protect them, they might be killed by the natives, and that then, if the murders were not punished, England would suffer loss of prestige. But is this the case? As a matter of fact, the number of travellers who lose their lives at the hands of the natives of the countries in which they are travelling is quite insignificant when compared with the number of those who return in safety. Let us, then, hope that the Kashgar mission may date the commencement of a new era, during which geographical enterprise may be encouraged, or at any rate not discouraged, amongst the officers of the army, and if few will now deny that a knowledge of Ashantee, of Yemen, of the northern and north-eastern frontiers of Persia, of Merv, Andkin, Maimana, Badakshan, and Wakhan, would have been of importance in the years just passed, it may not be forgotten that a knowledge of these countries may be of still more importance in a not far distant future. May we not take a hint in this respect from our now near neighbours in Central Asia, the Russians? No one who has followed their movements can fail to have been struck by the intense activity of their topographical staff—an activity that can only be compared to that of England at the period when Burnes, Eldred Pottinger, Wood, Abbott, Connolly, and others whose names are ever fresh in our memories, were penetrating into the wildest recesses of Central Asia. In alluding to the contributions of war to geographical science, it is perhaps hardly necessary to mention the very obvious manner in which military operations teach us geography by directing our attention for the time being to the country in which they are being carried on, or to the direct results that have followed many campaigns from the days of Alexander to our own. The Russians are indeed far in advance of us in all that relates to those survey operations and that geographical exploration which should always be carried on simultaneously with the advance of an expeditionary force into an unknown or but partially known country; they have long since realised the importance, almost necessity, of accurate geographical knowledge, based on sound systematic survey, and, having learned in time the lesson that opportunities once lost may never be recovered, make every effort to take advantage of those that are offered to them. In the expedition against Khiva each column had attached to it an astronomer and small topographical staff, whose duty it was to fix the geographical positions of all camps and map the route and adjacent country, whilst officers on detached duty were instructed to keep itineraries of their routes which might be fitted in to the more accurate survey. On the fall of Khiva an examination of the Khanate was at once commenced, and it was even thought necessary to send Col. Skobelof, disguised as a Turkoman, to survey the route by which Col. Markosof should have reached the oasis. It is much to be regretted in the interests of geography that some such system was not adopted during the recent operations on the Gold Coast, and that so little, comparatively speaking, has been added to our knowledge of Ashantee and the protectorate. The conclusion of peace with King Coffee, and the effect that must have been produced on the inland tribes by the destruction of Coomassie, appear to offer facilities for the examination of a new and interesting region which it is to be hoped will not be neglected by those who are able and willing to take part in the arduous task of African exploration.

The most important military contributions to geography have undoubtedly been those great topographical surveys which are either completed or in progress in every country in Europe except Spain, Turkey, and Greece. Frederick the Great was, I believe, the first to recognise that in planning or conducting operations on a large scale, as well as directing many movements on the field of battle, a commander should have before him a detailed delineation of the ground of a whole or part of the theatre of war. To supply this want, Frederick originated military topography, which, in its narrower sense, may be defined as the art of representing ground on a large scale in aid of military operations. It was found, however, that during war there was rarely sufficient time to construct maps giving the requisite information, and thus the necessity arose of collecting in peace such data as would enable maps to be prepared. In this necessity may be seen the origin of all national topographical surveys, including our own, which was commenced as a purely military survey in 1784 by General Roy, and transferred in 1791 to the old Board of Ordnance. The gradual development of these surveys, and the various stages through which they have passed before reaching their present state of excellence, need not be noticed here. Side by side with the large establishments engaged in the production of the topographical maps, there have grown up in most countries extensive departments, sometimes employing from fifty to sixty officers, whose duty it is to supplement the maps of their own and foreign countries by the collection of all information of whatever nature that may be useful in time of war. The brief interval that elapses between the declaration of war and the commencement of hostilities, the rapid movements of armies, and the short duration of campaigns at the present, have shown more clearly than ever the imperative necessity of previous preparation for war; and the publication of the great surveys of most European countries has given an impetus heretofore unknown to the studies I have alluded to.

The progress of the European surveys, and especially of our own, has been marked by many results which have indirectly influenced the advancement of geographical science. Such are the improvements in instruments made during the progress of the triangulation; the introduction of the Drummond light, Colby's compensating bars, &c.; the connection of the English and Continental systems of triangulation; the pendulum observations at various places; the measurement of arcs of the meridian; the comparison of the standards of length of foreign countries, of India, Australia, and the Cape of Good Hope, with our standard yard, which has recently been completed at the Ordnance Survey Office, Southampton. In the same category may be placed the improvements in the art of map engraving, in the application of chromo-lithography to the production of maps as exemplified in the Dutch process of Col. Bessler and the Belgian maps; and the employment of electrotyping to obtain duplicates of the original plates. The method of copying maps by photography without any error in scale, or any distortion that can be detected by the most rigid examination, was first proved to be practicable and was adopted in the Ordnance Survey Department in 1854, by Major-General Sir Henry James, for the purpose of facilitating the publication of the Government maps of the United-Kingdom on the various scales. Since that date the necessity of rapidly producing, multiplying, enlarging, and reducing maps has tended towards the development of the various photographic processes which have been brought to such a high state of perfection. During the last five years photographic negatives on glass covering an area of 10,071 square feet were produced at the Ordnance Survey Office for map-making purposes alone, and from these negatives 21,760 square feet of silver prints were prepared and used in the various stages of the Survey. An area of 959 square feet of the negatives was also used in producing 13,595 maps on various scales by the photozincographic process, which was also introduced by Major-General Sir Henry James. It was by similar processes that the Germans were enabled to provide the enormous number of copies of the various sheets of the map of France required during the war of 1870-1. Any comparison of the maps of various countries would necessarily occupy much time, so I will only add that as specimens of engraving the sheets of our one-inch map are unrivalled, and that no foreign maps can compare for accuracy of detail and beauty of execution with the sheets of our six-inch survey. Our great national Survey is the most mathematically accurate in Europe, and it speaks much for the ability of the officers who have brought it to its present state of perfection, that from the very first they recognised the necessity of extreme scientific accuracy in their work, and that they have never had to withdraw from the position they have taken up with regard to the many questions of detail that have arisen from time to time.

Before concluding this portion of my address I would draw your attention to the appliances used in the minor schools of this country for teaching geography, as they would seem to need some improvement. The appliances to which I allude are models or relief maps, wall maps, atlases, and globes. The use of models as a means of conveying geographical instruction has been too much neglected in our schools. If anyone considers the difficulty a pupil has in understanding the drawing of a steam-engine, and the ease with which he grasps the meaning of the working model, and how from studying the model and comparing it with the drawing he gradually learns to comprehend the latter, he will see that a model of ground may be used in a similar manner to teach the reading of a map of the same area. Relief maps of large areas on a small scale have their uses, but they are unsuitable for educational purposes on account of the manner in which heights must be exaggerated to make them appear at all; this objection, however, does not apply to models of limited areas on a sufficient scale, which always give a truthful and effective representation of the ground. One reason why models have not been more used has been their cost, but the means of constructing them with ease, rapidity, and at slight expense, are quickly accumulating as the six-inch contoured sheets of the Ordnance Survey are published. Instruction in geography should begin at home, and I would suggest that as the six-inch survey progresses each decent school throughout the country should be provided with a model and a map of the district in which it is situated. If this were done, the pupils would soon learn to read the model, and having once succeeded in doing this, it would not be long before they were able to understand the conventional manner in which topographical features are represented on a plane surface, and acquire the power of reading not only the map of their own neighbourhood, but any map which was placed before them. In our wall maps I think we have been too much inclined to pay attention to the boundaries of countries, and to neglect the general features of the ground. It is difficult to say whether the maps have followed the teachers or the teachers the maps, but I fear instruction in physical geography too often comes after that in political geography, instead of a knowledge of the latter being based on a knowledge of the physical features of the earth. My meaning may perhaps be explained by reference to a wall map probably well known to everyone, that of Palestine, which frequently disfigures rather than ornaments the walls of our schoolrooms. In this map there are usually deep shades of red, yellow, and green to distinguish the districts of Judea, Samaria, and Galilee, and perhaps another colour for the Trans-Jordanic region, with a number of Bible names inserted on the surface, whilst the natural features are quite subordinate, and sometimes not even indicated. There is perhaps no book that bears the impress of the country in which it was written so strongly as the Bible; but it is quite impossible for a teacher to enable his pupils to realise what that country is with the maps at present at his disposal. The first object of a wall map should be to show the geographical features of countries, not their boundaries, and for this purpose details should be omitted, and the grander features have special attention paid to them. In school atlases the same fault may be traced, physical features being too often made subordinate to political divisions; and there is also in many cases a tendency to overcrowd the maps with a multitude of names which only serve to confuse the pupil and divert his attention from the main points. The use of globes in our schools should be encouraged as much as possible, as there are many physical phenomena which cannot well be explained without them, and they offer far better means of conveying a knowledge of the relative positions of the various countries, seas, &c., than any maps. The great expense of globes has hitherto prevented their very general use, but some experiments are at present being made with a view to lessening the cost of the construction, which it is hoped may be successful. I cannot pass from this subject without alluding to that class of maps which gives life to the large volumes of statistics which are accumulating with such rapidity. On the Continent these maps are employed to an extent unknown in this country, both for purposes of reference and education, and they convey their information in a simple and effective manner.

I will only detain you to notice briefly a few of the most important geographical events of the year, and foremost amongst these ranks the publication of Dr. Schweinfurth's work which every one has recently been reading with so much interest and pleasure. Dr. Schweinfurth, who received the Founder's medal of the Royal Geographical Society this year, is, I am happy to say, amongst us at present, and has contributed a valuable paper on the oases of the Libyan Desert.

Lieut. Cameron, R.N., has reached Ujiji, and extracts from a journal which he has sent home will be read to you. The observations which he has made are of high value, and the presence of a trained surveyor on the shores of Lake Tanganyika cannot fail to be followed by great results. A short report of Dr. Nachtigall's travels has been prepared for this Section; and Dr. Rowe, who acted as Chief of the Staff to Sir John Glover during his recent operations on the Gold Coast, will read an interesting paper on the country passed through on the march to Coomassie and thence to the coast. Two Engineer officers, Lieuts. Watson and Chippendale, have recently left England to join Col. Gordon at Gondokoro, with the special object of surveying the territory over which Col. Gordon has been appointed Governor by the Khedive. In Algeria the French have been actively engaged on the survey of the country, and the exact level of the Choltmil-Rhir has been determined. Mr. Stanley's second expedition to the east coast of Africa, under the auspices of an English and American newspaper, should not remain unnoticed, and I cannot pass from Africa without expressing my deep regret at the death of Dr. Beke, whose travels in Abyssinia were rewarded by the gold medal of the society, and whose observations in that country were, for their great accuracy, of so much service during the Abyssinian war.

The survey of Palestine, a work which has been said by a distinguished German geographer to mark the commencement of a new era in geographical research, is progressing favourably, and has led to the formation of an American society for the exploration of the country east of Jordan, and of a German society for the exploration of Phœnicia. The Rev. Dr. Porter, from whose labours in Palestine everyone who has visited or takes an interest in the country has derived so much profit and pleasure, will read a paper on the lesser known parts of Eastern Palestine, which he has recently visited; and a paper on the progress of the survey has been prepared by Lieut. Conder, R.E., the officer in charge. Our own survey is, I regret to say, languishing for want of funds, whilst that of the Americans is receiving that support from the people which it deserves; the serious loss which the fund has experienced in the death of Mr. Drake, who recently succumbed to an attack of fever at Jerusalem, and who had previously devoted his best energies to the work, must be still fresh in your memories. Lieut. Gill, R.E., who accompanied Col. V. Baker last year on a tour to Meshed, and the head waters of the Atrek, has prepared an account of their journey. Some most interesting particulars of the visit of a portion of Mr. Forsyth's mission to the Great Pamir and Wakham have been kindly supplied by Col. Biddulph, R.A., from letters received from his brother, Capt. Biddulph. The success of the party has, however, been purchased by the loss of Dr. Stoliczka, who died from the effects of fatigue and exposure within a few marches of Leh. Mr. Delmar Morgan has prepared a very valuable paper on Russian travels in Central Asia in the 15th century. Mr. MacGahan, the correspondent of the *New York Herald*, whose remarkable journey across the Desert to join General Kaufmann's column when marching on Khiva astonished the Russians, has forwarded some interesting notes on the Russian expedition against Khiva.

In Australia the great geographical event of the year has been Col. Warburton's journey from Alice Springs, near Mount Stuart, on the line of overland telegraph, to Roebourne, in Nichol Bay, for which he was awarded the Patron's gold medal of the Royal Geographical Society. Such particulars of the journey as have been forwarded to me through the courtesy of the Colonial Office and of Mr. Dutton, the Agent-General for South Australia, will be communicated to you.

In America, whilst the coast and inland surveys have been progressing, Dr. Haydon, who was the first to disclose to us the strange beauties of the Yellowstone region, has been engaged in exploring a country equally wild and picturesque, the eastern half of Colorado. Other exhibitions have been doing good service in the Yellowstone country, Arizona, Oregon, and the Aleutian Islands, amongst them one sent out by Yale College, which, besides exploring new country, brought back five tons of specimens from the great fossil beds of Oregon and other places for the college museum. I cannot help thinking that in sending out these expeditions—for this is only one of a series—for the examination of the geography, geology, botany, zoology, &c., of some special district, Yale College has set an example which might well be followed by our own universities, and that Dublin, Oxford, and Cambridge might take more part than they have hitherto done in what may be called scientific exploration in the field. My old friend and fellow-traveller, Capt. Anderson, R.E., has been engaged as chief astronomer of the International Boundary Commission in running the 49th parallel through the unknown country between the Missouri and Saskatchewan, and a short account of the demarcation of the parallel and the country it passes through will be read to you. In the south, Commanders Lull and Selfridge have found practicable routes for ship canals from Greytown, by Lake Nicaragua, to Brito, on the Pacific, and by way of the Atrato, from the Gulf of Darien, to a point near Cupica, on the Pacific; the cost of the latter is estimated at twelve million pounds. In South America Prof. Orton has been extending our knowledge of the Amazon country; and I may mention the activity which the Peruvian Government is showing in promoting the exploration of the little-known districts of Peru. Mr. Hutchinson, late her Majesty's Consul at Callao, has forwarded a paper on the commercial, industrial, and natural resources of Peru, which will be found to give much interesting information on that country.

Dr. Carpenter will, I hope, give us some account of the cruise of her Majesty's ship *Challenger*, which cannot fail to interest the people of this town, from Prof. Wyville Thomson's former connection with it. Capt. Warren, R.E., whose name is so well known from his work at Jerusalem, has forwarded a valuable paper on reconnaissance in unknown countries; and Capt. Abney, R.E., will read one on a subject which he has made peculiarly his own—the application of photography to military purposes. M. Maunoir, the secretary of the French Geographical Society, has forwarded a paper on the objects sought to be obtained by the International Congress to be held at Paris in the spring of next year.

I regret that I am not able to give any definite information on the probability of Government assistance to Arctic exploration, but I understand that the impression produced on the members of the deputation which recently had an interview with the Prime Minister on the subject was that he was not unfavourable to such assistance. Admiral Sherard Osborn has kindly forwarded a paper on routes to the north pole, and Lieut. Chermside, R.E., who accompanied Mr. Leigh Smith on a very remarkable voyage last year to Spitzbergen, will read an account of the discoveries they were enabled to make. The reports of the officers of the *Polaris* have been published, expressing contradictory opinions as to the possibility of their having been able to reach a higher latitude. As regards the general subject of Arctic exploration, there can, I think, be no doubt that that by Smith's Sound would yield the most important scientific results, and would offer great facilities for reaching the Pole itself. It should not be forgotten that all recent Polar expeditions sent out from this country have been despatched with the special object of ascertaining the fate of Sir John Franklin, and that discovery was not a principal object. When, too, we consider that in these expeditions Arctic travel was reduced to a very perfect system, that the distance from the point reached by the *Polaris* to the Pole is less than has already been performed in some of the sledge journeys, and that no life has ever been lost on a sledge journey, it is impossible to doubt that a well-organised expedition would be able to reach the Polar area. In the words of a well-known Arctic explorer, "What remains to be done is a mere fleabite to what has already been accomplished." Morton, the second mate of the *Polaris*, says, as the result of his third voyage, that he is more than ever convinced of the practicability and possibility of reaching the Pole; and if I may express my own opinion, it would be in the words attached to a picture at the last exhibition of the Academy in London, "It is to be done, and England ought to do it."

REPORTS.

Report on the Rainfall of the British Isles for the years 1873–74.

We extract from the report the part relating to the rainfall of the British Isles during the years 1872–73. The very exceptional character of the rainfall of 1872 was mentioned in our last report, but in accordance with a custom which has now prevailed for twelve years, it was only incidentally referred to, the details being deferred until the two years 1872 and 1873 could be published together. This course, which was originally adopted with a view to economy in printing, has in the present instance had the fortunate result of bringing together two very remarkable features of each, of which we must speak separately.

Rainfall of 1872.—Records of rainfall have been collected and discussed in our previous reports, which enable us to compare the total fall in any year from 1726 to the present time with the mean fall. One of these tables (that facing p. 286 Brit. Ass. Report 1866) contains nine long registers, extending over 140 consecutive years, but the greatest excess even at a single station was only 58 per cent. (at Oxford in 1852). In 1872 this value was largely exceeded at a number of stations, as is shown by Tables I. and II., whence it appears that at fourteen stations out of 115, or 12 per cent., it exceeded this previously unparalleled value. At thirteen the excess was greater than 60 per cent., and it reached or exceeded 70 per cent. at the following stations:—

Shropshire, Shiffnall .	Rainfall	77	per cent. above average	1860–69.
" Shrewsbury .	"	75	"	"
" Hengoed, Oswestry	"	70	"	"
Northumberland, Bywell	"	77	"	"
Haddingtonshire, East Linton	"	70	"	"
Aberdeenshire, Braemar .	"	78	"	"

No similar falls have occurred since 1726, and there is no evidence of such a fall since rainfall observations were commenced, nearly two centuries ago. Full details respecting the monthly fall of rain in this very remarkable year are given in the appendix to this report, and we think it may be regarded as fortunate that so remarkable a fall has occurred at a period when, owing largely to the operation of this committee, the system of observation is in a state unprecedentedly near perfection.

The Rainfall of 1873.—If this year had stood by itself it would merely have been classed as a rather dry year, and would have soon passed into oblivion. Coming, however, immediately after such an exceptionally wet year, it has produced the unusual result of giving two consecutive years, one with twice the rainfall of the other, and in many instances with much more than twice. How rare is this occurrence may be judged from the fact that there is no case in the 140 years' table just referred to. The nearest approaches are—Chatsworth, in 1788, 19·86 inches, in 1789, 36·31, the former being 55 per cent. of the latter. A still nearer approach occurred at Cobham, in Surrey, in 1851 and 1852, when the totals were 17·38 and 34·19 inches respectively, the former being 51 per cent. of the latter. In Table II. no cases are admitted unless much more striking than the above. The districts in which these exceptional ratios occur are (as might be expected) principally those in which the excess in 1872 was greatest, but there are also a few of which the explanation is not so obvious. It is very satisfactory to feel that these two exceptional years have found in the British Isles the most nearly perfect system of observation in the world.

Your committee cannot close their report without expressing as far as words can do so the loss which they have sustained in the death of Prof. Phillips, one of the original members appointed in 1865, who, notwithstanding the numerous other demands upon his time, was always as willing as he was able to assist the committee in any of the various difficulties which the extent of their operations inevitably involve.

Preliminary Report on Dredging on the Coast of Durham and North Yorkshire.

The dredging off the coasts of Durham and North Yorkshire, provided for by a grant from the British Association last year, was carried out during the week beginning on the 13th July. A suitable vessel was engaged, and being on the whole favoured by the weather, we dredged every day until the 18th inclusive. During two days the R.A. M. Marman accompanied us. We were indebted to him for valuable assistance in naming some of our specimens, as well as for kindly undertaking to report on some sections of the work.

On two days out of the six the sea was too rough to allow of the dredges being worked very successfully, and one dredge was unfortunately lost by getting fast on hard ground while a very strong tide was running, but with these exceptions the work was carried out satisfactorily. The dredging ranged from near Tynemouth, on the north, to Scarborough, on the south, the water varying in depth from 20 to 45 fathoms, the greater portion of the time being devoted to a belt known to fishermen as the "inner fishing bank," lying from four to eight miles from the shore. One day, however, was spent at the greater distance of thirty to forty miles from shore, and another day at a distance of about seventeen miles.

Time has not allowed of anything more than safely to preserve and arrange our captures. On a future occasion we hope to give a full account of the results obtained.

NOTES

THE final programme of the Oriental Congress, to be held in London next month, was settled on Tuesday; we hope to be able to say something about it next week.

M. ALLUARD, director of the Meteorological Observatory which is being erected on the Puy-de-Dôme, regrets that, owing to the backward state of the works, the building cannot be opened in the end of September, as was expected. It is hoped, however, that the work of the Observatory will be commenced before winter. The construction of the telegraphic line which will connect the station on the plain at Clermont with the station on the summit of the Puy-de-Dôme has been completed. The formal inauguration will take place next summer. One main cause of the delay is owing to the fabulous prices demanded by the small proprietors through whose lands the approaches to the Observatory must be made; no blame whatever for the delay can be attached to the staff of the Observatory. The Government authorities, central and local, have shown the greatest zeal in forwarding the construction of the works.

THE Emperor of Austria has conferred the decoration of Knight of the Order of the Iron Crown, with a patent of hereditary nobility, on Dr. Julius von Haast, director of the Museum of Canterbury, New Zealand, in recognition of his eminent scientific merits and attainments.

SIR WILLIAM FAIRBAIRN, Bart., F.R.S., died on the 18th inst., in his eighty-fifth year, having been born at Kelso, in Scotland, in 1789. What Sir William has done to improve the manufacture of iron is well known. He was one of the founders of the British Association, and was its president in 1861. Many papers by Sir William appeared in the Philosophical Transactions, in the Reports of the British Association, and in the Transactions of the Philosophical Society of Manchester. Some of his works, however, were also published separately. Among his chief productions may be specified treatises on "Canal Navigation," on "The Strength and other Properties of Hot and Cold Blast Iron," on "The Strength of Locomotive Boilers," on "The Strength of Iron at Different Temperatures," on "The Effect of Repeated Melting upon the Strength of Cast Iron," on "The Irons of Great Britain," on "The Strength of Iron Plates and Riveted Joints," on "The Application of Iron to Building Purposes in General," on "Useful Information for Engineers," &c.

IT is stated that the Crown has appointed Mr. John Ferguson, M.A., to the chair of Chemistry in Glasgow University, vacant by the retirement of Dr. Thomas Anderson.

THE subscriptions announced up to Saturday last on behalf of the University of Edinburgh Buildings Extension Scheme amount to 69,017*l*. The total sum required from the public is 100,000*l*.

THE Council of the Ray Society, in presenting their Thirty-first Annual Report, congratulate the members on the continued prosperity of the Society. The arrears in the issue of the annual volumes, long a cause of much inconvenience, have been at length overcome. Since the last meeting, at Bradford, two volumes, those for the years 1872 and 1873, have been distributed; a third volume, that for the year 1874, is finished, and will be issued in October. The volumes for the years 1872 and 1873, consisting of the first part of the British Annelids, by Dr. McIntosh, although containing less text and fewer illustrations than in some of the previous memoirs, have been in the matter of production equally costly. The very beautiful plates, printed in colours by lithography, required many stones for their proper development, and necessitated a corresponding outlay. The volume for the present year, on the Spongiadæ, by Dr. Bowerbank, completing the series on that subject, and, illustrated by ninety-two plates, is also a most excellent example of work both on the part of the artist and the lithographer. As the cost of this volume has been in excess of the yearly income, it is hoped that a considerable addition of subscribers will justify the money expended. The proposition alluded to in the last Report, viz., that of reducing the price of certain of the earlier works of the Society, has been much appreciated by the members, and has proved a financial success. It has been suggested that the machinery of the Society might be more largely employed in the production of Monographs on the Fauna and Flora of Great Britain; the Council therefore solicit assistance from authors who possess the requisite knowledge and who may be willing to assist in the undertaking. In conclusion, the Council, in order to obtain funds sufficient to carry out the objects of the Society, urge upon members the necessity of gaining new subscribers.

IN an address recently delivered before the Dublin Obstetrical Society, Dr. Evory Kennedy discussed the development and spread of scrofula from an evolutionary point of view. This is an aspect of hereditary disease which admits of much extension; one which requires a much larger accumulation of statistics than we yet possess, and a far deeper insight into the physiological basis of pathology than we can expect for some time to come. There is one argument brought forward by Dr. Kennedy that deserves especial attention, which is, that as scrofula tends to early death, or the production of a few early dying offspring, the fact that it is not diminishing in its ravages proves that it is being continually developed *de novo* by surrounding circumstances. Is this not a sufficient stimulus for increased sanitary legislation?

THE Governor of Minnesota has called on the general Government for aid, as, owing to the ravages of grasshoppers for two years past, many thousands are suffering for want of food. The American naturalists suggest that the grasshopper should be eaten, just as it is in portions of Africa and Western Asia.

The new Minister of Public Instruction visited the Observatory of Paris last week, and expressed his satisfaction to M. Leverrier with what he had seen and with the explanations which had been given to him.

THE ownership of the grounds between the old Paris Observatory Gardens and the Boulevard Arago, more than two acres, has been disputed between the Government and the city of Paris. The right of the city was acknowledged, but the Municipal Council have let it to the Observatory for the nominal rent of 20 francs a year. On these grounds a magnetic service is to be established.

Two interesting balloon ascents have taken place in America lately, one at New York by Prof. Donaldson, with his large Transatlantic balloon, and a batch of reporters from several influential papers at New York. The trip, including four landings, lasted more than twenty-four hours, and ended in the vicinity of Saratoga, the balloon having run a distance of about eighty miles. A few days afterwards Prof. Wyse executed an ascent in Canada, in order to ascertain if a western current blows in the upper parts of the atmosphere when the lower stream of air is running in another direction. At a moderate height the western current was met with. Prof. Donaldson contends that it is a consequence of the revolution of the earth, and can be trusted to for crossing the Atlantic from America to Europe. But can these partial experiments be really relied upon? That remains to be demonstrated.

ONE of the very few scientific members of the Versailles Assembly has departed. M. Fland, an engineer, died at Dinan, where he was appointed Mayor seventeen years ago. He had an engine manufactory at Brest, and was appointed by contract the constructor of the celebrated Giffard injector. M. Fland was originally a pupil of the Ecole des Arts et Métiers d'Angers.

MR. THOMAS MUIR, M.A., F.R.S.E., Assistant Professor of Mathematics in the University of Glasgow, and author of some original investigations in Mathematics, has been appointed successor to Dr. Bryce in the Mathematical Mastership of the High School of Glasgow.

MR. CHARLES MOORE, the *Garden* states, who recently brought a good many valuable and very novel plants to this country from the South Sea Islands and Australia, returns to Sydney by the next mail, having visited many of the best botanic gardens and nurseries in Europe, and selected an immense collection of valuable and rare plants for the Sydney Botanic Garden, which is said to be one of the most beautiful in the world.

WE learn from *Iron* that the Academy of Sciences of Berlin offers a prize of 200 dols., payable in July 1876, for the best essay recording experiments as to whether changes in the hardness and friability of steel are due to chemical or physical causes, or to both. Papers in German, Latin, English, or French, are to be sent in before March 1876.

THE Report of the Council of the Leicester Literary and Philosophical Society, presented at the annual meeting of June 15 last, is on the whole very gratifying. The Society contains a large number of members, and is working in the right direction in trying to interest not only the members, but the inhabitants of Leicester generally, in science as well as literature. During last winter a very judiciously planned course of lectures was delivered in connection with the Society, which was fairly attended, and would, we believe, have been still better attended, had there been no free seats. The Society is divided into sections, three of which are scientific—(1) Meteorology and General Physics, (2) Geology and Palæontology, (3) Natural History. Satisfactory reports are given in Nos. 1 and 3, the latter having set itself to the collection of statistics of the natural history of the county, and the former, among other things, to a regular series of meteorological observations. We hope the Leicester Society will persevere in its work.

WE have received as No. 1 of the "Proceedings of the Chester Society of Natural Science," a very excellent list (with remarks) of birds observed in Werral, Cheshire, by J. F. Brockholes. The list contains 168 species.

THE Seventh Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology (Harvard) contains some account of the valuable series of objects connected with South American and Pacific archæology and ethnology, which the late Prof. Agassiz acquired during his voyage in the *Hassler* in 1871-2, and which have been transferred to the Peabody Museum. The collection is very valuable and comprehensive; there are 330 specimens of Peruvian skulls alone. The Report contains a very ingenious paper, apparently by Mr. J. Wyman, the Curator, On the human remains in the shell heaps of the St. John's River, East Florida, in which the author argues, from the condition of the bones and other circumstances, that the Floridan aborigines were in all probability cannibals.

ONE of the many valuable results of the work of the U.S. Geological Survey of the Territories, is a "Synopsis of the Flora of Colorado," by T. C. Porter and J. M. Coulter. This work is intended to be a type of a series of handbooks of different branches of natural history, to be published from time to time as a part of a series of "Miscellaneous Publications" for the use of students. No. 3 of the series is nearly ready, and has been prepared by the eminent ornithologist, Dr. E. Coues. It will form an octavo volume of several hundred pages, bringing the whole subject of western ornithology up to date.

A PAPER by Dr. H. D. Schmidt, of New Orleans, U.S.A., On the construction of the dark or double-bordered nerve-fibre, occupies a large part of the last number of the *Microscopic Journal*, and is illustrated by three plates. In the same number is the first instalment of a communication by Rev. S. J. Brakey on the theory of immersion.

THE additions to the Zoological Society's Gardens during the past week include two Chukar Partridges (*Cacabis chukar*) from N. W. India, presented by the Hon. Justice Jackson; four Sandwich Terns (*Sterna cantiaca*), four Avocets (*Recurvirostra avocetta*), European, purchased; a Common Crowned Pigeon (*Goura coronata*), two Bronze-winged Pigeons (*Phaps chalcoptera*), hatched in the Gardens; a Black-eared Marmoset (*Hapale penicillata*) from Brazil; and two Suricates (*Suricata zenik*) from South America, deposited.

FRENCH ASSOCIATION FOR THE PROGRESS OF SCIENCE

THE Lille Session was opened on Aug. 20 by the address of M. Wurtz, of which you have received a copy, and which has been published in all the French papers. The *Débats*, by an extraordinary access of zeal, published it a day before it was delivered!

On Friday Colonel Laussedat read at a general session a report on the results of the last session.

On Saturday evening a lecture on the Transit of Venus was delivered by M. Faye, before a very large audience at the Cercle du Nord, a magnificent building, richly fitted up. The accomplished astronomer referred mostly to the arrangements at the French stations, deeply regretting that all civilised nations had not been united into a kind of federation for working in combination at a problem of such magnitude; he hopes that it will be so in 1882. He insisted upon the importance of photography, which has been used to such good purpose by the Americans, and he trusts that in future times photography will take the lead in such observations. He gave interesting details as to the Yokohama station, to which a Japanese prince educated in France will be attached as a photographer. The consequence will be that M. Jannsen and his associates will be admitted into the interior sea of Japan, where, up to the present moment, not a single foreign vessel has ever sailed.

Owing to the coincidence of the meeting of the British Association at Belfast, scarcely any English *savans* are present here. The only British member I have seen up to the present moment is Dr. Sylvester, the celebrated mathematician. He has been nominated the honorary president of his section, the acting president being M. Catalan, who, though a Frenchman, is regarded as a representative of Belgium. Ten years ago he settled in Liége, where he is a professor in the University.

The interest felt by the people generally is not nearly so great as in the case of the British Association in England. The inhabitants of the city do not appear to understand fully the extent of the honour conferred on them. A *train de plaisir* has been organised to visit distant workshops, but Lille workshops have not been opened for inspection.

Newspapers are glad to publish the transactions of the several sections, but the Association has not authorised any one of them to publish them at full length.

Last Saturday a most interesting experiment was tried with success on the Northern line. M. Giffard, the inventor of the injector, has constructed a new waggon which is suspended by powerful springs at both extremities, thus completely avoiding oscillation. It is very easy to read and even to write in these new carriages. The invention will be exhibited very shortly to the English public. W. DE FONVIELLE

Lille, Aug. 23

OPENING ADDRESS BY THE PRESIDENT, M. WURTZ, AT THE MEETING OF THE FRENCH ASSOCIATION

The Theory of Atoms in the General Conception of the Universe

FRANCIS BACON conceived the idea of a society of men devoted to the culture of science. In his "New Atlantis," in which he describes the organisation of this society and its influence upon the destinies of a wisely governed people, he shows it rising to the dignity of a State institution. The progress of civilisation by the search for truth, and truth discovered in the order of nature by experiment and observation—such are the ends proposed and the means made use of. Thus, in an age when the syllogism was still supreme, and which was firmly held beneath the scholastic yoke, the English Chancellor assigned to science at once its true method and its mission in the world.

The plan of Bacon embraced all branches of human knowledge. The land was overrun by a multitude of observers, engaged, some in studying the monuments of the past, the language, the manners, the history of the nations; others in observing the configuration and the productions of the soil, noting the superficial structure of the globe and the traces of its revolutions, collecting all the data concerning nature, the organisation and distribution of plants and animals. Other men, located in various regions, cultivated the exact sciences. Towers were constructed for the observation of stars and meteors; vast edifices, arranged for the study of physical and mechanical laws, contained machines which supplied the deficiency of our forces, and instruments which added to the precision of the senses and rendered abstract demonstrations sensible. This immense labour was uninterrupted, co-ordinated, controlled; it had its origin in self-abnegation, it was regulated by precision, and had time for its sanction. Thus was it fruitful.

Such was the idea of Francis Bacon. To observe all things; by the rational comparison of these observations to disclose the hidden connections of phenomena, and to rise by induction to the discovery of their real nature and their causes, all with the view "of extending the empire of man over entire nature, and of executing everything possible for him to do;" such is the object which he has pointed out to us; such is the function of science.

This great exploration of the earth which he desired to institute, this patient and exact research of the laws of the universe, this deliberate intervention of science in the affairs of life and of the universe,—could all this be the work of his own time? He knew it too well to venture to hope it himself, and it is on this account, doubtless, that he placed the fortunate country which enjoyed so noble an institution in the solitude of the great ocean.

Two centuries and a half ago the conception of Bacon was regarded as a noble utopia; to-day it is a reality. That magnificent programme which he then drew out, is ours, gentlemen; ours, not in the narrow sense of the word, for I extend this programme to all who, in modern times and in all countries, give themselves to the search for truth, to all workers in science, humble or great, obscure or famous, who form in reality, in all parts of the globe and without distinction of nationality, that vast association which was the dream of Francis Bacon. Yes, science is now a neutral field, a commonwealth, placed in a serene region, far above the political arena, inaccessible, I wish I could say, to the strifes of parties and of peoples; in a word, this property is the patrimony of humanity. It is, too, the principal conquest of this century, which my illustrious predecessor characterised, with so much justice, as the century of science.

Modern generations are spectators, indeed, of a magnificent spectacle. For a century past the human mind has directed an immense effort to the study of the phenomena and the laws of the physical universe. Hence an astonishing development of all the sciences founded on observation and experiment. New ideas which have arisen in our days in the correlation and conservation of forces have been like a revelation to some of these sciences. Mechanics, physics, chemistry, physiology itself, have found at once a *point d'appui* and a bond of connection. And this powerful flight of ideas has been sustained by the progress of the methods, I should say by the more careful exactness of observations, the perfect delicacy of experiments, the more rigorous severity of deductions. These are the springs of this movement which hurry along the sciences, and of which we are the astonished and moved witnesses. It is to propagate it broadcast over our country that we hold, each year, this parliament, to which are invited all who take part or are interested in the war against the unknown. Science is indeed a war against the unknown; for, if in literature it is enough to give expression, and in art a body, to conceptions or beauties deposited either in the human mind or in nature, it is not so in science, where truth is deeply hidden. She must be conquered, she must be stolen, like the Promethean fire.

It is of some of these conquests that I wish to speak to-day, full of doubt and apprehension in presence of so great a task. To respond to the demands of his position and to follow noble examples, your president ought, at the beginning of this session and of the ceremonies which inaugurate our young association, to trace the progress accomplished in the sciences, mark by a few bold lines the various routes over which it has recently run, and the culminating points which it has attained. I shrink from such a programme: if it does not exceed the powers of some of my colleagues, and doubtless of some among you, it greatly surpasses mine. Less justified and less daring than was Condorcet at the end of last century, I only perceive the outlines and some bright patches of the sketch which he attempted to draw; and to see it accomplished, I shall call to my assistance those who will follow me in the honourable and perilous post I now occupy.

I shall confine myself, then, gentlemen, to speaking to you of what I know, or of what I think I know, by directing your attention to the science to which I have devoted my life.

Chemistry has not merely grown, it has been regenerated since Lavoisier. You know the work of that immortal master. His labours in connection with combustion gave to our science an immovable basis by fixing at once the notion of simple bodies and the essential character of chemical combinations. In these latter we find in weight all that is ponderable in their elements. These, in uniting to form compound bodies, do not lose any of their proper substance; they lose only an imponderable thing, the heat disengaged at the moment of combination. Hence that conception of Lavoisier that a simple body such as oxygen is constituted, properly speaking, by the intimate union of the ponderable matter oxygen with the imponderable fluid which constitutes the principle of heat, and which he named caloric—a profound conception, which modern science has adopted, giving it a different form. It is, then, unjust that, in recent times, Lavoisier should be accused of having misconceived what is physical in the phenomenon of combustion, and that an attempt should be made to rehabilitate the doctrine of Phlogiston which he had the honour of overturning. It is true that in burning bodies lose something: "It is the combustible principle," said the partisans of Phlogiston; "It is caloric," said Lavoisier; and he adds, an essential thing, that they gain in oxygen.

Thus Lavoisier perceived completely the phenomenon, of which the great author of the phlogiston theory, G. E. Stahl, had only a glimpse of the external appearances, and of which he misconceived the characteristic feature. Such is, gentlemen, I maintain, the foundation and the origin of modern chemistry. Is that to say that the monument raised upon these bases by Lavoisier and his contemporaries subsists in all its parts, and that it was accomplished at the end of last century? It would not be from want of materials, and even in its outlines we may notice lines which have in time disappeared. It has then been added to and in part transformed; but it still rests upon the same foundations. Such has been in all sciences and in all times the lot of theoretical conceptions; the best of them contain obscurities and gaps which, on disappearing, become the occasion of important developments or of a new generalisation.

That of Lavoisier embraced especially the bodies best known in his time, *i.e.*, the compounds of oxygen, the true nature of which was discovered by him in his researches on combustion. All these bodies are formed of two elements; their constitution is binary, but it is more or less complicated. Some, oxides or acids, contain a simple body united to oxygen; others, more complex, are formed by the combination of acids and oxides among themselves, a combination which gives rise to salts. These last then are formed of two constituent parts, each of which contains oxygen united to a simple body. Such is the formula of Lavoisier on the constitution of salts; it is in harmony with the fundamental idea which he enounced on chemical combination, an idea according to which all compound bodies are formed of two immediate elements, which are either simple bodies or themselves compound bodies.

This dualistic hypothesis was embodied, in his time and with his consent, in French nomenclature, the work of Guyton de Morveau, the principle of which may be thus summarised: two words to designate each compound, one to mark the genus, the other the species. Thus, one of the fundamental conceptions of the system of Lavoisier—dualism in combinations—found a striking expression in the binary structure of the names, and is, as it were, insinuated into the mind by the very terms of chemical language; and we know what is, in such a case, the power of words.

The great successor of Lavoisier, Berzelius, extended to the whole of chemistry the dualistic hypothesis of Lavoisier on the constitution of salts. Wishing to give it a solid support, he added to it the electro-chemical hypothesis. All bodies are formed of two constituent parts, each of which possesses, and is, as it were, animated by, two electric fluids. And as the electro-positive fluid attracts the electro-negative, it is natural, it is necessary that in every chemical compound the two elements should reciprocally attract each other. Is not the one carried towards the other by electric fluids of opposite kinds? We see that the hypothesis of Berzelius gives at once a striking interpretation of the dualism in combinations and a simple and profound theory of chemical affinity. This elective attraction which the final particles of matter exercise upon each other was referred to electric attraction.

Another theoretic conception gave a body to the electro-chemical hypothesis, and has given since a solid basis to chemistry as a whole. We speak of the atomic theory, revived from the Greeks, but which took, at the commencement of this century, a new form and a precise expression. It is due to the penetration of an English thinker, Dalton, a teacher of chemistry in Manchester in the beginning of the century. It was less a pure speculation of the mind, as were the ideas of the ancient atomists and of the philosophers of the Cartesian school, than a theoretical representation of well-established facts, viz., the parity of the proportions according to which bodies combine, and the simplicity of the relations which express the multiple combinations between two bodies.

Dalton found, in fact, that, in cases where two substances combine in several proportions, if the quantity of one of them remains constant, the quantities of the other vary according to very simple relations. The discovery of this fact was the starting-point of the atomic theory. Here is the substance of this theory:—That which fills space, viz. matter, is not infinitely divisible, but is composed of a universe of invisible, imperceptible particles, which, nevertheless, possess a real extension and a definite weight. These are atoms. In their infinitely attenuated dimensions, they offer points of application to the physical and chemical forces. They are not all like each other, and the diversity of matter is owing to inherent differences in their nature. Perfectly identical for the same simple body, they differ from one element to another in their relative weights, and perhaps by their form. Affinity sets them in motion, and when two bodies combine with each other, the atoms of the one are drawn towards the atoms of the other. As this approach always takes place in the same manner between a determinate number of atoms, which are in juxtaposition one to one, or one to two, or one to three, or two to three—in other words, according to very simple proportions, but invariable for a given combination—it results therefrom that the smallest particles of this combination present a fixed composition rigorously similar to that of the entire mass.

Thus the most important fact of chemistry, the immutability of the proportions according to which bodies combine, appears as a consequence of the fundamental hypothesis that chemical combinations result from the coming together of atoms possessing invariable weights. Berzelius compared these atoms to minute magnets. He imagined them to have two poles where the two electric fluids are separated but unequally distributed, so that one of them is in excess at one of the poles. "There exists," he said, "atoms with excess of positive fluid and others with excess of negative fluid; the first attract the second, and this attraction, the source of chemical affinity, preserve the atoms under all combinations. At the moment that these last are formed they are set in motion; in the completely formed compound they are at rest, and are divided as if into two camps, at once kept together and maintained in opposition by the two electric fluids of opposite kinds.

Thus the electro-chemical theory, ingeniously adapted to the hypothesis of atoms, raised the dualism of Lavoisier to the dignity of a system, which appeared solidly established during the first half of this century. The facts then known were included in it without difficulty, and the rich materials which the patience or the genius of experimenters amassed without ceasing were very soon co-ordinated.

Without attempting to enumerate the older works relating to the decomposition of alkalis, to the nature of chlorine recognised as a simple body, to various newly-discovered elements, such as selenium, tellurium, iodine, we shall mention in a special manner among so many discoveries, that of cyanogen, which we owe to our own Gay-Lussac. The demonstration of the chemical functions of this compound gas, which behaves like a simple body, which is capable of forming the most varied combinations with true elements, which finally, when it is engaged in such combinations lends itself to double decompositions, as does chlorine in the chlorides, was a great step in the progressive march of science. Hence the definition: cyanogen is a compound radical, and the triumphant appearance of the doctrine of radicals. It had been vaguely intimated by Lavoisier; it really dates from the discovery of cyanogen, and will make a rapid advance. Up to that time great efforts had been directed to the side of inorganic chemistry, and great ideas had arisen in this domain. The application of these ideas to organic chemistry, upon which attention then began to be directed, presented some difficulties.

We know that the innumerable bodies which nature has distributed in the organs of plants and animals contain a small number of elements—carbon, hydrogen, oxygen, and often nitrogen. It is then not in their general composition that they differ, but by the number and arrangement of the atoms which enter into their composition. By increasing more or less and grouping themselves in various manners, these atoms give rise to an immense multitude of distinct compounds which are true chemical species. But what is the arrangement of these atoms? What is the structure of these organic molecules, so much alike in the nature of their elements, so wonderful in the infinite diversity of their properties? Berzelius solved this question without hesitation. Comparing organic compounds to the bodies of inorganic chemistry, he divided both classes of atoms into two lots, grouping on one side carbon and hydrogen, electro-positives, and on the other, oxygen, electro-negative. And when, at a later time, chlorine was artificially introduced into organic compounds, the atoms of this powerful element were ranged on the side of oxygen, both being invariably found in binary combinations of which they formed the electro-negative element, the atoms of carbon and hydrogen constituting the electro-positive radical.

Thus the great promoter of inorganic chemistry attempted to fashion organic molecules according to the image of those molecules of dead matter which he had studied so thoroughly. The paths which Lavoisier traced in this domain he wished to extend to the world of products formed under the influence of life; they resulted in a dead-lock. In proportion as the riches of science increased it was necessary, in order to uphold the system, to accumulate hypotheses, to invent radicals, to construct, with insufficient or imaginary data, formulæ more and more complicated—a thankless task, in which the feeling of experimental realities and sober appreciation of facts often gave place to outrageous reasonings and vague subtleties. These barren efforts of a great mind inaugurated the decline or marked the termination of the dualistic ideas which were at the foundation of what has been called, improperly perhaps, the old chemistry. The new began at that point. Great discoveries, cleverly and boldly interpreted, gave it an impulse which still endures.

. There were then—I speak of forty years ago—a number of young men, with Dumas and Liebig at their head, in the opposite camp, who cultivated with ardour the investigation of organic compounds. Convinced that the constitution of these compounds could only be deduced from the attentive investigation of their properties and metamorphoses, they undertook to investigate these bodies themselves, to transform them, to torment them in some sort by the action of the most diverse reagents, in the hope of discovering their intimate structure. And this is, gentlemen, the true method in chemistry; to determine the composition of bodies, and by careful analysis of their properties to fix, as far as possible, the grouping of their ultimate particles. This, then, is the glory of our science, and the single but precious contribution which it is able to furnish for the solution of that eternal problem, the constitution of matter.

From the researches which were made at this epoch and in this spirit, an all-important fact issued; it relates to the action of chlorine on organic compounds. This simple body deprives them of hydrogen and may be substituted for that element, atom for atom, without affecting the molecular equilibrium and without, adds Dumas, modifying the fundamental properties. This proposition encountered at first the most violent contradiction. How could chlorine take the place of hydrogen and play its part in combinations? These two elements, said Berzelius, are endowed with opposite properties, and if the one is lacking the other cannot supply its place; for, in short, they are two inimical brothers, little disposed and by no means fit to be kept in the same house. These critics and many others have not prevailed against facts. The theory of substitutions has come triumphantly out of this great discussion, which marks a date in the history of our science. Its natural development has gradually introduced into it new ideas on the constitution of chemical compounds, on the mode of combination of the elements which they contain.

These ideas have come to light by various ingenious comparisons. Laurent considered organic compounds as formed of nuclei with appendages, both the one and the other admitting into their structures atoms grouped with a certain symmetry. Dumas compared them to edifices of which the atoms constitute, in a manner, the materials. Hence the graphic but frequently correct expression, of molecular edifices capable of being modified, in certain cases, by the substitution of one part for another, and which, in other cases, the shock of powerful reagents may shatter to pieces. In both conceptions the chemical molecules were regarded as forming a whole. A little later Dumas compared them to planetary systems; and here he veritably shot ahead of his time in giving us a glimpse of groups of atoms maintained in equilibrium by affinity, but carried along by movements, as the planets of a solar system are acted upon by gravitation and carried into space. It is in these movements of atoms and molecules that at a later period the source of the physical and chemical forces must be sought for; but I must not anticipate. I have attempted to show how the ideas on chemical combinations have been gradually modified under the double influence of the atomic hypotheses and of facts brought to light by the French school concerning their reciprocal replacement in combinations. Forming a whole, more or less complex, the molecules of organic substances may be modified by substitution and give rise to a multitude of derivatives which naturally attach themselves to the mother substance. The latter serves them as a model or type. The typical idea thus introduced into science very soon occupied a large place. It first brought to it important elements of classification. All the compounds derived by substitution from the same body were ranged in the same family, of which the latter was, so to speak, the chief. Hence arose groups of bodies perfectly distinct from each other, and the number of which were being constantly increased by daily discoveries. It was necessary not only to introduce order into all these tribes, but to connect them with each other by a common bond. The honour of having discovered the superior principle of classification belongs to Laurent and Gerhardt, valiant champions of French science, from whom premature death has snatched, if not victory, at least the gratification of victory. Laurent was the first to say that a certain number of mineral and organic compounds possessed the constitution of water, and this idea, brilliantly developed by Williamson, was generalised by Gerhardt. According to the last named, all inorganic and organic compounds may be connected with a small number of types, of which hydrochloric acid, water, and ammonia, are the chief. In these compounds, relatively simple, one element may be replaced by another element, or by a group of atoms performing the function of a radical, so that this substitution gives rise to a multitude of various compounds bound together by the analogy of their structure, if not by the harmony of their properties.

This last point was novel and important. Bodies belonging to one type and similar in their molecular structure may differ much in their properties: these depend not only on the arrangement of the atoms, but also on their nature. Thus the inorganic and organic bodies ranged under the type water, are, according to the nature of their elements or their radicals, powerful bases, energetic acids, or indifferent substances—a great and bold idea, which has established a connection between the most diverse bodies, and which has definitely overturned the barriers which use had raised, and which the weakness of theory had maintained, between inorganic and organic chemistry. And yet this was only a stage in the march of ideas. By what right and by what privilege, it was said, may the relatively simple compounds we have named serve as types for all others, and why should nature be restricted to make all bodies on the model of hydrochloric acid, water, and ammonia? This was a serious difficulty, but it has been removed; it became the occasion of a profound discussion and the germ of a real progress.

These typical compounds represent at bottom various forms of combination, the diversity of which it is necessary to refer to the nature of the elements themselves. The latter impress on each of these compound types a particular character and a special form. The atoms of chlorine are so formed that to one of them only a single atom of hydrogen needs to be added to form hydrochloric acid; then that an atom of oxygen takes two atoms of hydrogen to form water; that an atom of nitrogen requires three to constitute ammonium; and that an atom of carbon demands four to become marsh-gas. What a difference in the power of combination of these elements, and, so to speak, in their appetites for hydrogen! And will this difference not be connected with some peculiarities in their mode of existence, to some property inherent in matter itself, and which will impress on each of these hydrogenic compounds a special form? Such is the case.

It is now admitted that atoms are not motionless, even in bodies apparently the most fixed and in completely formed combinations. At the moment when these are being formed the atoms come into violent collision with each other. In this conflict a disengagement of heat is ordinarily observed, resulting from the expenditure of active energy which the atoms have lost in the *mêlée*, and the intensity of this heat-phenomenon gives the measure of the energy of the affinities which have presided at the combination. But there is another thing in chemical phenomena besides the intensity of the forces at work, and which are more or less exhausted by a disengagement of heat; I refer to their *mode*; it was of this elective attraction that Bergman spoke a century ago, and which governs the form of the combinations. The atoms of the various simple bodies are not endowed with the same aptitude for combination with each other; they are not equivalent to each other. This is what is called atomicity, and the fundamental property of atoms is without doubt connected with the various modes of motion by which they are animated. When these atoms combine with each other, their movements require to be reciprocally co-ordinated, and this co-ordination determines the form of the new systems of equilibrium which will be formed; that is, the new combinations.

It is with atoms thus endowed that chemists now construct molecular edifices. Resting at once upon the data of analysis and on the investigation of reactions, they express the composition of bodies by formulæ which mark the nature, the number, and the arrangement of the atoms which each molecule of these bodies contains. But what! is this merely an ingenious exercise of the mind? and the construction of formulæ by means of these symbolic materials which are selected, which are arranged so as to give to the molecular edifice a determined form,—is this a mere matter of curiosity? By no means. These formulæ, by whose aid are expressed the composition of bodies and the constitution of their molecules, offer also a valuable aid for the interpretation of their properties, for the study of their metamorphoses, for the discovery of their reciprocal relations,—all things which are intimately connected in each body with the nature and arrangement of the atoms. Now, the investigation and comparison of these formulæ furnish to the inquiring spirit the elements of a powerful synthesis. What treasures have been acquired by science by this process, which consists in deducing the transformations of bodies from their molecular structure, and in creating, by a sort of intuition, new molecules by means of those already known! The artificial formation of a number of combinations, the syntheses of as many organic compounds as nature alone seemed to have the privilege of forming—in a word, the greater part of chemical discoveries which have enriched science and the world for twenty years—are founded on this inductive method, the only efficacious and the only rational one in the sciences. I shall cite only one example among many others.

A happy chance led to the discovery of that brilliant substance, of a bright purple, which is known under the name of fuchsine or rosaniline. Analysis determines its composition, skilled investigations find its molecular structure. Soon it is known how to modify it, to multiply the number of its derivatives, to vary the sources of their production, and from attentive study of all these reactions, issue a pleiad of analogous substances whose diverse colours rival in brilliancy the richest tints of the rainbow. A new and powerful industry has already resulted from all these investigations, which theory has followed step by step and guided the fertile evolution. In this order of investigation, science has recently gained one of her most striking triumphs. She has succeeded in forming at once the colouring matter of madder (alizarin). By an ingenious combination of reactions, and by theoretic reasonings still more ingenious, MM. Graebe and Liebermann have succeeded in obtaining this body synthetically, by means of anthracene, one of the numerous bodies which is now obtained from coal-tar, the impure source of so many wonders. Such is a discovery which has issued from the womb of science, and of science the most abstract; confirming preconceived ideas on the relations of composition and of atomic structure between anthracene, alizarin, and the intermediate terms. And this will not be the last product of this beautiful development of chemistry. Future conceptions on the intimate structure of complex organic compounds will be so many landmarks for new syntheses, and hypotheses rigorously deduced from acquired principles will be fruitful in the happiest applications.

Saccharine matters, alkaloids, other complex bodies whose properties and diverse transformations are actively investigated with a view of deducing their molecular constitution—all these substances may be artificially reproduced, as soon as this preparatory work, so difficult and often seemingly so useless, will have sufficiently advanced. So fine a programme justifies the great efforts which have been made, in our days, in this direction. To discover, to analyse, to study, to classify, to reproduce artificially so many diverse substances, to study their internal structure, to indicate their useful applications; to surprise, in a word, the secrets of Nature and to imitate her, if not in her processes, at least in some of her productions—such is the noble aim of contemporary science. She can only reach it by the sure but slow paths we have indicated; experiment guided by theory. In chemistry, at least, empiricism has had its day; problems, clearly stated, must be boldly faced, and henceforth the rational conquests of experiment will only leave a place more and more circumscribed for fortunate finds and the surprises of the crucible. Away, then, with the detractors of theory, who go in quest of discoveries which they can neither foresee nor prepare; they reap where they have not sown. But you, courageous workers, who trace methodically your furrows, I congratulate you. You may be sometimes deceived, but your work will be fruitful, and the goods which you amass will be the true treasure of science.

Will not this science be one day embarrassed and as if encumbered with so much riches, and will the strongest memory be able to support all the weight? If the danger exists, there is no need to fear it. The classification of all these materials will free us from embarrassment. In a well-arranged edifice, each stone requires to be prepared before taking its place; but the construction accomplished, all do not strike the eye equally, though each has its use; only the strong courses, the corner-stones and the salient parts, are noticed. It will be thus with the monument of science. The details which have for their end to fill up gaps will disappear in the great whole, of which we only need consider the foundation, the principal lines, and the crowning of the edifice.

Gentlemen, chemistry thus constituted, and physics, have between them necessary connections. Both the one and the other investigate the properties of bodies, and it is evident that, so far as the ponderable bodies are concerned, these properties must be intimately connected with the constitution of matter. Hence the atomic hypothesis which suffices for the interpretation of chemical phenomena ought also to be adapted to physical theories. This is the case. It is in the movements of atoms and of molecules that we now seek, not only the source of the chemical forces, but the cause of the physical modifications of matter, changes of condition which it can undergo, phenomena of light, of heat, of electricity, of which it is the support.

Two French *savans*, Dulong and Petit, discovered some time ago a very simple law which connects the weights of atoms with their specific heats. It is known that the quantities of heat necessary to change by one degree the temperature of the unit of weight of bodies are very unequal. This is what we call specific heats; but the quantities of heat which bring about in simple bodies, taken under conditions in which they are rigorously comparable, the same variations of temperatures, are equal, if we apply these quantities of heat not to the unit of weight but to the atomic weight; in other words, the atoms of these elementary bodies possess the same specific heats, though their relative weights are very unequal.

But as to this heat which is thus communicated to them, and which raises their temperature equally, what is in reality its mode of action? It augments the intensity of their vibratory movements. Physicists recognise heat as a mode of motion, and that it comes under the cognisance of our perceptions by the vibrations of atomic matter or ether; of ether, that fluid material perfectly elastic, incoercible, imponderable, which fills all the immensity of space and the depth of all bodies. It is in this fluid that the stars describe their orbits; in this fluid atoms perform their movements and describe their trajectories. Thus the ether, the radiant messenger of heat and light, conveys and distributes their radiations through all the universe; and that which it loses in vibratory energy when it penetrates a cold body, which it warms, it communicates to the atoms of this body and augments the intensity of their movements; and that which it gains in energy by contact with a warm body, which it cools, it withdraws from this body and diminishes the intensity of their vibratory movements. And this kind of light and heat which come from material bodies is transmitted across space to other material bodies. You will remember in reference to this the words which Goethe put into the mouth of the Prince of Darkness in cursing the light—"It is born of bodies, it is brought forth and maintained by bodies, and it will perish with them."

But this exchange of forces which circulate from ether to atoms and from atoms to ether, must it manifest itself always in the phenomena of light or heat? This vibratory force which is transmitted by ether, can it not be preserved and stored up by matter, or appear under other forms?

It can be preserved as affinity, liberated as electricity, transformed into dynamic movements. It is this which is stored up in the innumerable compounds elaborated by the vegetable kingdom; it is this which provokes the decomposition of carbonic acid and of the vapour of water by the most delicate organs of plants which blossom in the sunlight. Originating with the sun, luminous radiation becomes affinity in the immediate organic principles which are formed and accumulated in vegetable cellules. That mode of motion of ether which was "light" is become another mode of motion which is "affinity," and sways the atoms of an organic compound. In its turn this force thus stored up is expended again when the organic compounds are destroyed in the phenomena of combustion. Affinity, satisfied and as it were lost by the combination of combustible elements with oxygen, again becomes heat or electricity. Wood in burning, and carbon in becoming oxidised, produce sparks or flames: a metal which exhausts its affinities in decomposing an acid warms the liquid, or, under other conditions, produces an electric current, warming it less when the current is exterior. And in another order of phenomena, heat which distributes or propagates itself unequally between two surfaces, rubbing one against the other, or in a crystal that is warmed, or in two metals united by solder, disappears partially as such and manifests itself as static electricity or as an electric current. Thus all these forces are equivalent to one another and appear under diverse forms, whether they are passing from atoms to ether or from ether to atoms; but we never see them disappear or lose their force—only transform themselves and perpetually renew their youth.

And this is not all. These vibratory movements which sway atoms and which whirl about in ether can cause movements of the mass, displacement either of the bodies or of the molecules. Warm a bar of iron, it will dilate with a force almost irresistible; a part of the heat will be employed in producing a certain pulling asunder of the molecules. Warm a gas, it will in like way dilate, and a part of the heat disappearing as such, will produce a separation very considerable in this case between the gaseous molecules; and the proof of the consumption of heat in the work of dilation is not difficult to give, for if you warm the same gas to the same degree, but prevent it from dilating, less heat need be given to it than in the former case. The difference between the two quantities of heat corresponds exactly to the mechanical work performed by the molecules in dilatation. That is one of the most simple considerations, on which is founded the principle of the mechanical equivalent of heat so often now referred to in mechanics, in physics, and in physiology.

In physics it explains the mystery of latent heat, of fusion, and of volatilisation. But how is it that heat supplied continuously to a boiling liquid to maintain ebullition does not ever raise the temperature of the liquid above a point which under similar pressure remains fixed? The reason is that this heat is continually absorbed, and disappears as such to produce the mechanical work of driving apart the molecules. And so in the phenomena of fusion, the constancy of the temperature indicates the absorption of the heat consumed in molecular work. These conceptions have modified and thrown much light on the definitions which physicists have applied to different states of matter, and it is seen that they are in harmony with chemical theories of the constitution of bodies. These are formed of molecules which represent systems of atoms animated by harmonic movements, and whose equilibrium is exactly maintained and strengthened by these movements.

Applied to molecules thus constituted, heat can produce three different effects. In the first place, an elevation of temperature by the increase of vibratory energy; in the second place, an increase of volume by the driving apart of atoms and molecules, and this augmentation becoming very considerable, a change of condition, solid becoming liquid, and liquid becoming gas; in the last, the driving apart of the molecules is become immense in relation to their dimensions. Thus acting on the atoms which compose the molecule and amplifying their trajectories, heat can disturb the equilibrium which exists in the system, causing a conflict of these atoms with those of another molecule in such a way that this disturbance or this conflict leads to fresh systems of equilibrium, that is to new molecules. There commence the phenomena of decomposition and dissociation, or, inversely, of combination, which is the mainspring of chemistry, and it is seen they are but the continuation or consequence of the physical phenomena we have just analysed, the same hypothesis, that of atoms, applied to one and the other with an equal simplicity.

I ask, will it not be easy to conceive that the physical and chemical forces which act on ponderable bodies are applied also to diffuse continuous matter in some way, and is it not natural to suppose that there are limited and definite particles which represent the points of application of all these forces? And this view ought to apply to the two sorts of matter which form the universe, ether and atomic matter, the one infinitely rarefied but homogeneous, filling all space, and in consequence enormous in its mass, both unseizable and imponderable; the other non-continuous, heterogeneous, and only occupying a very limited portion of space, although it forms all worlds.

Yes, it forms all worlds, and the elements of ours have been discovered in the sun and in the stars. Yes, the radiations given off by incandescent atomic matter which forms these stars are also, for the most part, those which are produced by the simple bodies of our planet. Marvellous conquest of physics which reveals at once to us the abundance of forces which environ the sun and the simplicity of the constitution of the universe!

A solar ray falls upon a prism and is turned aside in its path and decomposed into an infinity of different radiations. These take each a particular direction, and all range themselves in bands in juxtaposition, and spread themselves out in the spectrum if the light thus received and decomposed is thrown on to a screen. The visible part of this spectrum shines with all the colours of the rainbow; but besides this, beyond both ends of the coloured bands the radiations are not absent. The heat-rays can be made to reveal themselves beyond the red; the chemical rays, more powerful than the others to make and destroy the chemical combinations, are known beyond the violet. All the forces which manifest themselves on the surface of our globe, as heat, light, and chemical energy, are sent to us in a ray of white light.

But this brilliant spectrum is not continuous. Fraunhofer has discovered in it an infinity of black lines cutting the shining band; these are the "dark lines" of the spectrum, and Kirchhoff has found that a certain number of them occupy the same position as the "bright lines" which occur in the spectra of metallic substances when in a state of incandescence. This last physicist, generalising an observation of Foucault, has seen, further, that under given circumstances these bright lines can be obscured and "reversed," coinciding then with the dark lines of the solar spectrum.

We have been able to conclude that these have an identical origin and are due to radiations given off by metallic substances spread in vapour over the solar globe, radiations which are obscured by these same vapours in the atmosphere of the sun. Thus the star which gives us heat, light, and life, is formed of elements like those which form our globe. These elements are hydrogen and metals in a state of vapour. They are not distributed equally in the mass of the sun and in his rarefied envelopes; the hydrogen and most volatile metals are raised to a greater height on the surface of the sun than are the other metals. They are never in repose; this ocean of incandescent gas is continually agitated by tremendous tempests. The *trombes* throw themselves out in immense columns to the height of 50,000 leagues above the gaseous sphere; these are the "protuberances," and they shine with a rose light peculiar to themselves; and they are formed according to Janssen and Lockyer by hydrogen, very rarefied, and also by an unknown substance—"helium." The luminous globe itself, the photosphere, gives the spectra of our ordinary metals, except gold, silver, platinum, and mercury; the precious metals, those which have little affinity for oxygen, being wanting. But, on the contrary, in the solar spectrum there are "lines" different from those which the metals of our earth give, but which are like them. The lines of the metalloids are wanting, as are the lines which are characteristic of compound bodies. The gaseous mass has such an incandescence that no chemical combination could withstand it.

The lines of Fraunhofer are dark, only the lines of the protuberances and those seen a moment after the disappearance of the sun in an eclipse, and a moment before its reappearance, are bright, like those which characterise the spectra of incandescent metallic vapours. Here we have a curious relationship which has furnished most important and precise indications on the physical constitution of the sun.

I have spoken of the chemistry of the sun, but the spectroscope has explored all the far-off space of heaven. The light of hundreds of stars has been analysed, and nebulæ, scarcely visible, have had the quality of their radiations revealed by its aid. The light, in some cases very feeble, with which a number of stars shine, gives a spectrum with dark lines like the solar spectrum, and this fact proves to us that the constitution of these stars is like that of our sun. Aldebaran sends us records of hydrogen, magnesium, and calcium, which abound in solar light, but also those of metals which are rare or absent, as tellurium, antimony, and mercury.

Nebulæ, twenty thousand times less brilliant than a candle a a distance of 400 metres, have still given a spectrum, for their light, although feeble, is very simple in its constitution, and the spectrum which it gives consists only of two or three bright bands, one of hydrogen, the other of nitrogen. These nebulæ which give a spectrum of bright lines, are those which the most powerful telescopes cannot resolve: there is an "abyss" between them and resolvable nebulæ, which, like ordinary stars, give a spectrum with dark lines.

What an effort of the human mind! To discover the constitution of stars of which the distances even are unknown; of nebulæ which are not yet worlds; to establish a classification of all the stars, and still more to guess their ages—ah, tell me, is not this a triumph for science? Yes, we have classed them according to their ages. Stars coloured, stars yellow, stars white; the white are the hottest and the youngest; their spectrum is composed of a few lines only, and these lines are dark. Hydrogen predominates. Traces of magnesium are also met with, of iron, and perhaps of sodium, and if it is true that Sirius was a red star in the time of the ancients, it owed perhaps its tint to the greater abundance of hydrogen at that epoch. Our sun, Aldebaran, Arcturus, are among the yellow stars. In their spectra the hydrogen lines are less developed, but the metallic lines are fine and numerous. The coloured stars are not so hot, and are older. In consequence of their age they emit less vivid light. In them there is little or no hydrogen. Metallic lines abound, but one also finds channelled spaces like the lines of compounds. The temperature being lower, these latter can exist whether they consist of atoms joined to others of the same kind, or whether they contain groups of heterogeneous atoms. In referring recently to this classification of Father Secchi and the distribution of simple bodies in distant stars, Lockyer has observed that the elements the atoms of which are lightest are to be found in the hottest stars, and that the metals with high atomic weights are, on the contrary, met with in the colder stars; and he adds this—Are not the first elements the result of a decomposition brought about by the extreme temperatures to which the latter are exposed, and, taking them altogether, are they not the product of a condensation of very light atoms of an unknown primordial matter, which is perhaps ether?

Thus is brought forward afresh, from considerations taken from the constitution of the universe, this question of the unity of matter which chemistry has before raised from a consideration of the relative weight of atoms. It is not solved, and it is probable that it never will be in the sense here indicated. Everything leads to the belief in the diversity of matter, and the indestructible, irreducible nature of atoms. Does it not require, as M. Berthelot has pointed out, the same quantity of heat to put them in motion, whether they are heavy or light, and ought not the law of Petit and Dulong to prevail in its simplicity against the opposite hypothesis, however ingenious it may be?

I have endeavoured, gentlemen, to trace out for you the most recent progress accomplished in chemistry, in physics, and in physical astronomy, sciences so diverse in their object, but which have a basis in common—matter—and one supreme object—a knowledge of its constitution and of its properties and of its distribution in the universe. They teach us that the worlds which people infinite space are made like our own system, and that this great universe is all movement, co-ordinated movement. But new and marvellous fact, this harmony of the celestial spheres of which Pythagoras spoke, and which a modern poet has celebrated in immortal verse, is met with in the world of the infinitely little. There also all is co-ordinated movement, and these atoms, whose accumulation forms matter, have never any repose; a grain of dust is full of innumerable multitudes of material unities each of which is agitated by movements. All vibrates in the little world, and this universal restlessness of matter, this "atomic music," to continue the metaphor of the ancient philosopher, is like the harmony of worlds; and is it not true that the imagination is equally bewildered and the spirit equally troubled by the spectacle of the illimitable immensity of the universe and by the consideration of the millions of atoms which people a drop of water. Hear the words of Pascal: "I wish to picture not only the visible universe, but the immensity of nature that one can conceive within the limits of an atom; one may picture there an infinity of worlds, where each has its firmament, as in the visible universe."

As to matter, it is everywhere the same, and the hydrogen of water we meet with in our sun, in Sirius, and in the nebulæ, everywhere it moves, everywhere it vibrates, and these movements which appear to us inseparable from atoms, are also the origin of all physical and chemical force.

Such is the order of nature, and as science penetrates it further, she brings to light both the simplicity of the means set at work and the infinite variety of the results. Thus, through the corner of the veil we have been permitted to raise, she enables us to see both the harmony and the profundity of the plan of the universe. Then we enter on another domain which the human spirit will be always impelled to enter and explore. It is thus, and you cannot change it. It is in vain that science has revealed to it the structure of the world and the order of all the phenomena; it wishes to mount higher, and in the conviction that things have not in themselves their own *raison d'être*, their support and their origin, it is led to subject them to a first cause—unique, universal God.

SCIENTIFIC SERIALS

THE *Mittheilungen aus dem Gottingen Anthropologischen Vereine*, which are edited by Dr. Hermann von Jhering, promise to give important contributions to the department of anthropological science, and the appearance of these selections from the Transactions of the Society will be hailed with satisfaction. The first number contains an interesting paper on the origin of our knowledge of iron and bronze in Europe, by Prof. F. W. Unger, in which the author considers *seriatim* (1) the application of bronze for religious or sacrificial objects; (2) the linguistic affinity of the terms for ores, or metal generally, in different languages; (3-6) the mythical references to their use, seat of original works and the modes of employing bronze for and in connection with ceremonies of cremation. The section under which Prof. Unger treats of the myths and sagas connected with the history of the discovery and the first working of metals is especially interesting in regard to the early knowledge of iron possessed by the Tschudi, or primitive people of the Altai, through whom he believes that the Indo-Germanic races derived their acquaintance with its sources and modes of working.—A paper on skulls of extreme breadth, by Dr. von Jhering, which is rather a compendium of what has been done towards the definition of normal and abnormal types than a contribution of original matter, is aptly supplemented by the description of a new craniometer, given in the concluding extracts of the Transactions by Dr. W. Sprengel, who draws attention to the important direction taken by craniometrical inquiries in the course of the last year by the introduction of Dr. von Jhering's horizontal-plane apparatus, of which plates and detailed explanations are appended by the writer.—In a paper on the very widely-spread custom of tattooing the human body, in which some inquirers have believed they could trace the earliest origin of the art of using graved and written characters to express ideas, Herr Krause considers whether in this far-extending practice we have not an argument in favour of the unity of the human race. The author is not of opinion that we are justified in accepting this suggestion as capable of proof, but he thinks that this practice, against which Moses warned the Israelites, had a far higher significance than that of mere personal ornamentation, and was probably at one time or other associated with the religion of the several peoples who adopted it, while it also served as an emblematic emblazonment of the pretensions or calling of the wearer, a talismanic or hieroglyphic form of speech, and as a permanent pictorial exponent of facts in the absence of any other written language.

CONTENTS

PAGE
Fifth Report of the Science Commission 331
The International Prehistoric Congress of Anthropology and Archæology—Stockholm Meeting. By Dr. George Harley, F.R.S. 332
Armstrong's "Organic Chemistry" 333
Letters to the Editor:—
  Mr. Herbert Spencer and Physical Axioms.—R. B Hayward . 335
  Darwin on "The Origination of Life."—A Disciple of Darwin . 335
  Meteors.—Thos. H. Waller 336
Another New Comet. By J. R. Hind, F.R.S. 336
The British Association at Belfast 336
  Section B.—Opening Address by the President 337
  Section E do. do do. 339
Reports 342
Notes 343
The French Association. By W. de Fonvielle 344
Opening Address by the President, M. Wurtz, at the Meeting of the French Association 345
Scientific Serials 350

THURSDAY, SEPTEMBER 3, 1874

*FIFTH REPORT OF THE SCIENCE COMMISSION**

II.

So much has been written recently here and elsewhere on the origin and growth of the admirable Owens College, Manchester, that we shall not repeat the details on these points furnished by the Report of the Commission. Since it was opened in 1851, it has held its way through many discouragements, and now, despite its comparatively narrow income, it is, at least from the point of view of scientific teaching and research, one of the most efficient institutions in the kingdom. Considering its comparatively recent origin and its provincial situation, the gifts bestowed upon it have been almost lavish; and yet the same complaint is made in the case of the Manchester College as is made by the two London institutions: the efficiency of the work of the College, and especially of its scientific side, is seriously crippled from want of adequate resources.

The whole endowments of the College, from its foundation till the present time, have amounted to 34,582*l.* In connection with the recent movement for the erection of new buildings, including various general and special endowments, an additional 168,300*l.* has been obtained; but even this is short by 60,200*l.* of the sum required to carry out the proposed extensions. With the prospect of this deficiency the Governors of the College cannot at present undertake the establishment of any new chairs. If, however, they had adequate resources, it has been stated that they would probably proceed to divide the professorship of English and its History, and to found new chairs of Mixed Mathematics, of Applied Geology and Mining, of Astronomy and Meteorology, and of Architecture.

The total number of students in Owens College in 1873-4 was 356, being an increase of 19 on the previous year, and excluding 140 students belonging to the Medical School.

The number of students entering the evening classes in 1872-3 was 557, which in 1874 rose to the very large number of 889.

With regard to the Owens College, the Commission makes the following recommendation:—

"Considering the strenuous and persevering efforts made by the great commercial community by which the Owens College is surrounded, and the cordial sympathy which these efforts have evoked, and which has manifested itself in the incorporation of other societies and schools with the College, and in the subscriptions and benefactions for special objects by which the exertions of the governing body have been seconded; we are of opinion that this institution has established a claim to aid from the national funds. We therefore recommend, in accordance with the views which we have expressed with regard to the two metropolitan colleges, that the Owens College should receive assistance from Government both in the form of a capital sum to be regarded as a contribution towards its building fund, and also in the form of an annual grant in aid of its working expenses, with the especial view of enabling it to complete the curriculum of studies by the establishment of new chairs."

The Newcastle College of Physical Science originated in a feeling on the part of the authorities of the University of Durham, that that University did not completely meet the educational wants of the North. To render the University more generally useful, it was thought that the best step that could be taken would be to establish a School of Physical Science in connection with it. Newcastle, as the site of this school, was preferred to Durham, in deference to the wishes of all the eminent local employers of labour.

The College was founded in 1871 for the teaching of physical science, particularly in its practical application to engineering, mining, manufactures, and agriculture. The funds necessary for its endowment were provided in part by the University of Durham, which gave, in the first instance, 1,000*l.* a year in perpetuity, which has since been increased; and, in part, by a subscription raised in the north of England.

From local sources, and by amalgamating with the College the other scientific institutions of Newcastle, 117,000*l.* may be obtained.

The amount originally subscribed was of course insufficient to provide buildings for the new institution, and the College has at present to pay rent for the premises which it occupies. It is the opinion of the witnesses that it is extremely desirable that the College should be provided with buildings of its own. Sir William Armstrong says: "We consider the present accommodation as a makeshift, but without Government assistance it would be scarcely possible to undertake" to provide separate buildings appropriated solely to the College.

It was proposed, in the first instance, to provide four professorships, viz., of Pure and Applied Mathematics, of Chemistry, of Experimental Physics, and of Geology. To these professorships, lecturers have been added in literary subjects, in Greek and Latin, in English History and Literature, in French, and in German, besides a lectureship in Mechanical Drawing. It is thought very desirable by the founders of the College that other professorships of Science should be added to those already founded; indeed, a professorship of Biology has been recently established.

The number of students in 1873-4 was 78. The course of study is one of two years, there being two examinations, one at the end of each year; the candidates who pass the formal examination in Physical Science at the end of the second year to receive the title of Associate in Science of the University of Durham.

"There appears," the Report states, "to be every reason to think that the Newcastle College of Science is serving a most useful purpose in its own neighbourhood. There can be no doubt that local colleges in the great centres of manufacturing industry are in a position to meet local requirements which central institutions in London or the national universities are unable to do.

"According to Sir Wm. Armstrong the character of the instruction should be mainly, or almost entirely, of a purely scientific character, because at present there is no difficulty as regards practical knowledge, while on the other hand there is no means of acquiring scientific knowledge.

"The claims which the promoters of the College consider themselves to have upon the Government for assistance are founded upon the national usefulness of the institution, and on the amount of local support which it has received. Sir William Armstrong's view is that the promoters 'have a very sound claim upon the Government, considering how liberally the scheme has been supported locally. I think it would be a very fair thing if the Government, considering how much the nation benefits from the establishment of such colleges, in every case were to contribute a sum proportional to what has been raised in the locality towards the attainment of the object.' . . . .

---

* Continued from p. 332.

"We concur to a considerable extent in the opinions expressed by these witnesses. The degree of success which has attended the College of Physical Science at Newcastle-upon-Tyne, both in the collection of local subscriptions and in the organisation of its system of instruction, leads us to express with confidence the hope that by further efforts of the same kind it will before long be placed in a position to establish its claim to assistance from the State."

With regard to the Catholic University of Ireland, while the Commission believes that it is calculated to do much good to the cause of scientific education, it cannot recommend Government to grant it any endowment.

"On a review of the evidence," the Report states, "we are satisfied that the establishment of the Scientific Faculty of the Catholic University has not been without advantage to the instruction of the Irish people, an advantage which might be considerably increased if this faculty could be more completely organised, and its professors increased in number and supplied with adequate means for practical teaching. And we have not failed to observe that at the present time fresh efforts are being made by the persons interested in this institution, to improve and to render more widely available the instruction afforded by it.

"It is also indisputable that the Catholic University has received, and still continues to receive, a large amount of pecuniary support. The permanency, however, of this support, which proceeds, to a large extent at all events, from annual subscriptions levied by clerical agency, cannot be predicted with any certainty.

"The peculiar organisation of this institution," the Report concludes, "the religious restrictions imposed upon the selection of scientific professors and lecturers—restrictions the removal of which it would be idle to anticipate; the incompleteness of a large portion of its arrangements for the teaching of science, and the uncertainty of its income, preclude us from recommending that it should receive a grant from public funds."

The general outcome, then, of the Fifth Report of the Science Commission is, that University and King's Colleges, London, and Owens College, Manchester, ought certainly to receive assistance from Government, that the Newcastle College is in a fair way to prove that it deserves such assistance, and that it would not be advisable to subsidise the Catholic University of Ireland, as it is at present constituted.

J. S. K.

THE APPLICATION OF THE LAWS OF SELECTION TO AGRICULTURE

IN every phase of life the law of selection comes into play. At one time it is natural, at another time it is more or less artificial. At every time, and in every place, we see evidence of the plastic character of the materials on which the vital principle operates.

In devoting my holidays to an agricultural tour in England this season, I have visited several seed-growers who are conferring great advantages on the public by careful selection of parent-plants. I can speak on this point with the experience which a wide range of observation gives. I have myself, by selection, doubled the quantity of solid matter in turnips, and nearly doubled the number of seeds in ears of wheat.

If the principle of selection were universally applied with skill and care in the raising of our seed corn, what an enormous increase would thereby be made to the wealth of the agricultural classes of Great Britain and Ireland!

In our agricultural live stock a series of results, which are truly marvellous, have been accomplished by selection. And yet the principle is understood or practised only by a very small percentage of our farmers.

If any reader wishes to understand in a general way the change that has been made within the last quarter of a century, which is the measure of the life-time of the Royal Agricultural Society of England, let him take the Society's prize lists of 1839 and 1874. In the interval, several new breeds of sheep and cattle have come to be recognised as having distinct types. Nature has had her share in the work. The soil and climate of every district impress certain characters and qualities on the animal; and, in his artificial selection, the farmer preserves these in whole or part. In studying, some years ago, the origin of the older breeds, I was much struck with the extent to which their distinctive characters were due to the natural conditions under which they rose. And in a recent inquiry into the history of the newly-established breeds, the same leading truth has become still plainer.

To give point to this short paper I derive an illustration from the influence exercised on the art of sheep-breeding by the remarkable change which, common observation tells us, has taken place in the material of garments in common use. I refer to the well-known fact that tweeds and coarse cloths are now much more commonly used than in the last generation. To meet the demand thus created the farmer has produced sheep which carry wool of longer staple than the old breeds.

My argument is well illustrated in the great plains in the west of Ireland, where the flock-owners have established a splendid new breed, called the Roscommon Sheep. In the production of this variety the breeder has of course exercised his skill in selection. He crossed Leicester tups of the very best English strains of blood with the native ewe; and he repeated this over and over again until he obtained an animal of the type which suited him. Nature aided him in his art. It may be safely asserted that some of the peculiarities of the wool, as well as some of the peculiar conformations of the body, have been the work of Nature. And it is in retaining what was so well done by Nature that the highest skill is manifested. In England the best example of the argument is possibly afforded by the Lincoln breed of sheep, which stands so deservedly high in public estimation, affording as it does great weight of carcase with a remarkably heavy fleece of lustrous wool. Then, again, let us take the dark-shaded breeds—South Down, Shropshire Down, Oxford Down, and Hampshire Down. The South Down used to be more popular than it is now. It has been giving way in many places to an animal with a larger frame and with a fleece longer in the staple. The first that arose to displace it was the Shropshire, which has been followed by the Oxford Down. Each of these breeds pays best under a given set of circumstances; and this only shows the wide field open to British farmers for profiting by the laws of selection.

I look to the development of this great principle as one of the soundest and surest means of promoting the interests of the agricultural classes.

THOMAS BALDWIN

DARWIN'S "CORAL REEFS"

The Structure and Distribution of Coral Reefs. By Charles Darwin, M.A., F.R.S., &c. Second edition, revised. 1874; pp. 268. (Smith, Elder, and Co.)

THE rising generation of naturalists and geologists has not had, and most probably will never have, such feelings of intellectual pleasure as fell to the lot of the first readers of Charles Darwin's book on Coral Reefs, which was offered to science more than thirty years since. The recent researches into the nature of the deposits of the deep sea, and the discoveries of the bathymetrical zones of water of very different temperatures, are certainly full of vast interest, and will afford the data for the development of many a theory; but the clear exposition of facts, and the bold theory which characterised the book on Coral Reefs, came unexpectedly and with overpowering force of conviction. The natural history of a zoophyte was brought into connection with the grandest phenomena of the globe—with the progressive subsidence of more or less submerged mountains, and with the distribution of volcanic foci. The forces of the organic and inorganic kingdoms were shown to unite in the production of those circular growths of coral which appeared to rise from profound oceanic depths; and it was made evident that the existence and persistent growth of fragile Porites and *Madreporæ* were dependent upon movements of the crust of the globe, the result of forces acting almost from the beginning—upon movements so vast, equable and slow, that over thousands of square miles the coral grew upwards, whilst the supporting rock, its base, and the mother crust subsided in a wonderful unison. The pristine condition of the globe was in fact brought in relation with the formation of those beautiful islands, the theme of romance and poesy, the delight of the missionary, the dread of the navigator, and which should be, according to Dana, the luxurious home of enervated and used-up investigators.

The theory of the formation of barrier reefs and atolls is stated with Darwin's usual lucidity:—"From the limited depths at which reef-building polypifers can flourish, taken into consideration with certain other circumstances, we are compelled to conclude that both in atolls and barrier reefs the foundation to which the coral was primarily attached has subsided; and that during this downward movement the reefs have grown upwards." "There is not one point of essential difference between encircling barrier reefs and atolls; the latter enclose a simple sheet of water; the former encircle an expanse with one or more islands rising from it. Remove the central land, and an annular reef like that of an atoll in an early stage of formation is left." It was necessary, in order that this theory should be valid, that the depth at which reef-building corals can exist below the surface should be ascertained, and also that direct or indirect proofs of subsidence over a vast area should be offered. The nature of the bottom of the sea immediately surrounding Keeling atoll was carefully examined, and moreover soundings with the wide bell-shaped lead, with tallow armings, were carefully taken, off the fringing reefs of Mauritius. In Keeling atoll outside the reef it was found, "to the depth of ten or twelve fathoms the bottom is exceedingly rugged and seems formed of great masses of living coral, similar to those on the margin. The arming of the lead here invariably came up quite clean, but deeply indented, and chains and anchors which were lowered in the hopes of tearing up the coral were broken." "Between 12 and 20 fathoms the arming came up an equal number of times smoothed with sand and indented with coral; an anchor and lead were lost at the respective depths of 13 and 16 fathoms. Out of twenty-five soundings taken at a greater depth than 20 fathoms, every one showed that the bottom was covered with sand." Off the reef at Mauritius, "from 15 to 20 fathoms, the bottom was with few exceptions either formed of sand or thickly coated with Seriatopora (one of the Tabulata). At 20 fathoms one sounding brought up a fragment of Madrepora which I believe to be the same species as that which mainly forms the upper margin of the reef; if so, it grows in depths varying from 0 to 20 fathoms. Between 20 and 23 fathoms I obtained several soundings, and they all showed a sandy bottom with one exception at 30 fathoms, when the arming came up scooped out as if by the margin of a large Caryophyllia." "The circumstance of the arming having invariably come up quite clean when sounding within a certain number of fathoms off the reef of Mauritius and Keeling atoll (8 fathoms in the former case and 12 in the latter), and of its having always come up (with one exception) smoothed and covered with sand when the depth exceeded 20 fathoms, probably indicate a criterion by which the limiting of the vigorous growth of coral might in all cases be ascertained." Darwin admits that this limit might be exceptionally transgressed, but insists upon the importance of the gradual change, as depth progresses, from living clean coral to a smooth sandy bottom, in endeavouring to fix the depth at which the reef-builders can grow.

Even at this period of Darwin's life, the importance of the struggle for existence had been recognised by him, and had influenced his thoughts. He remarks that "we can understand the gradation only as a prolonged struggle against unfavourable conditions." All subsequent investigations by many independent observers have proved the correctness of this bathymetrical limit of the flourishing of reef-builders, and of late years the general characters of the coral which can exist at a greater depth and even on oceanic floors have been shown to differ essentially from those of the forms which live and flourish amidst the rush of the wave and surf. Darwin notices that where the sea is very shallow, as in the Persian Gulf and in parts of the East Indian Archipelago, the reefs lose their fringing character and appear as separate and irregularly scattered patches, often of considerable area. Around the Philippines the bottom of the sea is "entirely coated by irregular masses of coral, which, although often of large size, do not reach the surface and form reefs." There are huge clumps of Porites and many sponges on the floor of the sea off Cuba, but although these corals belong to reef-building genera, still as species they are not those which grow on flourishing reefs. The reef-builders evidently grow with great rapidity, and their struggle against the tide and currents and waves necessitates a constant process of reparation or of growth to replace fractured branches. They flourish in the warm, highly aërated, rushing water, which is full of living things—their proper food. Beyond the reach and influence of these conditions other species and genera exist, which add to the bulk of the coral mass, but which of themselves would never build up a reef, and it is some of these which have been dredged up from considerable depths. The simple corals and the branching forms without a cellular exotheca to hold them together have an enormous bathymetrical range, and can live in water of 76° F. close to the surface, and also at a depth of more than 1,000 fathoms in a temperature of less than 32°. But the true reef-builder requires a high temperature, and it therefore becomes very important to discover, as has been suggested by Dr. Carpenter, whether the vast sub-zone of cold water which underlies the superficial and heated water has not much to do with this restriction of certain species to definite depths. We must wait for the results of systematic dredging at great depths in the Pacific before this question can be for ever settled, but at present all our knowledge tends to prove that this deep stratum of cold water would prevent reef-builders from living at any considerable depth, and therefore that they never could have risen by growth from the ocean floor itself. Growing, therefore, on submerged rocks, the reef-builders must have their foundation slowly subsiding, if they are to attain a great thickness and to assume the bulk and the characters of atolls. The direct proofs of subsidence advanced by Mr. Darwin were noticed especially in Keeling atoll. "Appearances indicating a slight encroachment of the water on the level are plainer within the lagoon: I noticed in several places, both on its windward and leeward shores, old cocoa-nut trees falling with their roots undermined and the rotten stumps of others on the beach, where the inhabitants assured us the cocoa-nut would not grow. Capt. Fitzroy pointed out to me near the settlement the foundation-posts of a shed, now washed by every tide, but which the inhabitants stated had seven years ago stood above high-water mark." "From these considerations I inferred that probably the atoll had subsided to a small amount: and this inference was strengthened by the circumstance that in 1834, two years before our visit, the island had been shaken by a severe earthquake, and by two slighter ones during the ten previous years." The observations of such authorities as Williams, Kotzebue, and Stutchbury, respecting the encroachment of the sea on, and the destruction of parts or the whole of islands, were noticed by Darwin in his early edition, and comparisons were made, as in the case of Whitsunday Island, between old and new charts, in support of the evidence of subsidence. The existence of submerged or dead reefs is very properly advanced as an indirect proof of subsidence, and the condition of the Great Chagos bank was considered to explain the effects of a rapid subsidence which killed the corals. But the principal and most interesting evidence is afforded by the relative positions of active volcanic vents and barrier reefs and atolls. Darwin noticed the absence of active volcanoes in the presumed areas of subsidence, and their frequent presence in areas of elevation, the exceptions being very few. In acknowledging Dana's suggestive criticism that he had not laid sufficient weight on the mean temperature of the sea in determining the distribution of coral reefs, Darwin very properly urges that some other cause must account for the absence of coral growth in localities where the surface temperature of the sea is sufficient, and he refers especially to the islands which rise up from the abyssal sea in the Atlantic; but he indicates that temperature evidently has much to do with the absence of reefs on the west coast of Tropical America, the cold current reducing the mean emperature of the sea there below 68°.

Although investigations made subsequently to those of Darwin add almost invariably to the proofs of his theory of atoll formation, and it is received as correct by every teacher, still there have been one or two able criticisms of its general applicability. For instance, Semper, in his description of the Pelew Islands, doubted the evidence of subsidence. His opponent, with his usual justice and candour, gives Semper's objections the most careful consideration, and indeed they deserved this treatment. "He (Semper) states that the southern islands consist of coral rock upraised to the height of from 400 to 500 feet; and some of them before their upheaval appear to have existed as atolls. They are now merely fringed by living reefs. The northern islands are volcanic, deeply indented by bays, and are fronted by barrier reefs. To the north there are three true atolls. Prof. Semper doubts whether the whole group has subsided, partly from the fact of the southern islands being formed of upraised coral rock; but there seems to me no improbability in their having originally subsided, then having been upraised (probably at the time when the volcanic rocks to the north were emptied), and again having subsided. The existence of atolls and barrier reefs in close proximity is manifestly not opposed to my views. On the other hand, the presence of reefs fringing the southern islands is opposed to my views, as such reefs generally indicate that the land has either remained stationary or has been upraised. It must, however, be borne in mind that when the land is prolonged beneath the sea in an extremely steep slope, reefs formed there during subsidence will remain closely attached to the shore and will be undistinguishable from fringing reefs. Now, the submarine flanks of most atolls are very steep; and if an atoll after upheaval and before the sea had eaten deeply into the land and had formed a broad flat surface, were again to subside, the reefs which grew to the surface during the subsiding movement would still closely skirt the coast." The appendix, which contains a detailed description of the reefs and islands in the well-known coloured map, is of the greatest value to the physical geographer, and it includes notices of nearly every known coral tract.

After reading and pondering over this long-prized work, there comes the feeling that Mr. Darwin should at some future time enlarge its scope and deal with the distribution of coral species, and trace back in time the reefs of old. Who would not be glad to be taught from the vigorous pen of the man whose theory has lasted more than thirty years, and will last as long as science, what was the condition of the vast Pacific area prior to the age of reefs, and atolls? Mountains of different heights are now more or less submerged, and either capped with vast thicknesses of coral, or their tops are girt with barrier and fringing reefs. Take away the sea and the coral growth, and imagine the conditions which prevailed during the slow piling up of these volcanic rocks, their denudation and final overwhelming by the inrush of the ocean incident to the first phase of subsidence. Little is known concerning the age of the raised reefs of the Pacific, and therefore of the duration of the existing state of things; but in the Caribbean there have been reefs in consecutive ages since the early Cretaceous period, and in that area there have been during past ages subsidences and upheavals with contemporaneous volcanic action, following the same laws as those so elaborately described by Darwin as influencing coral growth in the Pacific.

P. M. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Long Peruvian Skull

IT was not my intention to have replied to Dr. J. B. Davis's letter on "The Long Peruvian Skull" in NATURE, vol. x. p. 123, as I shall have an opportunity before long of presenting the subject in detail before scientific readers. I find, however, by letters from England that an answer is expected from me. To me, it seemed little more than a reiteration of his disbelief in the existence of such a type; while it leaves unnoticed what I specified as the main point in the discussion.

Dr. Davis demands the production of "half a score of ancient Peruvian dolichocephalic skulls, the appearance of which totally precludes the possibility of interference by art, or other deforming process." Had an anonymous correspondent so stated the issue, I should have supposed that the writer had never seen half a score of Peruvian skulls in his life. The collection presented by Mr. Hutchinson to Prof. Agassiz numbered 368; and out of this Prof. Wyman reports only *eleven* not flattened or distorted. Is Dr. Davis prepared to rule the remaining 357 out of court as of no value in relation to his brachycephalic type? This question of Peruvian long and short heads must be settled in connection with a deforming element affecting both types, or it cannot be settled at all. Hence my specification of the real issue. Keeping this in view, I must beg leave meanwhile to refer, for the sake of brevity, to my statements in NATURE, vol. x. p. 48, in reference to examples previously adduced; while I now point out others easily accessible to Dr. Davis.

The large collection furnished to Prof. Agassiz was obtained, apparently at one time, from a single locality, "Ancona and its neighbourhood." Hence no doubt the uniformity of type. Doubling this number of skulls from the same locality would add nothing to the evidence. It is otherwise with the London Anthropological Institute. Its collection was obtained at different times, partly from the same accessible locality; but also from Santos, Ica, Passamayo, and Cerro del Oro. These include places hundreds of miles apart; and Prof. Busk, after minute study, reports that the evidence of the existence of a dolichocephalic type afforded by the collection, though "not very abundant, *is nevertheless decisive*."

It is a case precisely analogous to the remarkable dolichocephalic British type recognised by the acute sagacity of the late lamented Dr. Thurnam, in the Uley, Kennet, Littleton Drew, Rodmarten, and other long barrows in Wiltshire, &c., as illustrated in the *Crania Britannica*, for which so great a debt of gratitude is due to Dr. Davis and his gifted colleague. Those dolichocephalic skulls are exceedingly rare; they are found along with brachycephalic skulls; but, as Dr. Thurnam showed, accompanying elements suggestive of the latter as an inferior or servile class. Long ago, in a paper in the *Canadian Journal* of September 1862, I referred to the analogy this presents to the long Peruvian skull mingling in the ancient Inca cemeteries with crania of a markedly diverse type.

No multiplication of specimens of the less rare brachycephalic skull of the British cist or round barrow will invalidate this exceedingly rare but valuable dolichocephalic British type produced by Dr. Thurnam; and the exhibition of a whole ship's cargo of brachycephalic skulls from the accessible coast cemetery of Ancona is equally ineffective in disproof of the rare Peruvian dolichocephalic skull of Titicaca and other ancient burial-grounds.

Dr. Davis refers to an error in one of the woodcuts of my first edition of "Prehistoric Man." To anyone conversant with the difficulties of a Canadian author correcting proof-sheets for the London press, the chances of error, with proofs passing while the woodcuts were in the engraver's hands, and their mere titles or blank spaces in lieu of them, must be obvious enough. Dr. Davis will find the error pointed out in the preface to the second edition.

University College, Toronto, Aug. 6 DANIEL WILSON

Pollen-grains in the Air

I AM very sorry to find that, owing to my absence from home at the time, a question addressed to me by Mr. A. W. Bennett, in NATURE, vol. ix. p. 485, has escaped my notice hitherto and remained unanswered. Mr. Bennett, alluding to my letter on "Microscopic Examination of Air" (NATURE, vol. ix. p. 439), asks on what ground I refer the "triangular pollen" captured on my slide to the birch and hazel. The identification resulted from comparison under the microscope. The pollen-grains which I obtained from catkins of birch and hazel exhibited three conspicuous equidistant prominences (pores) giving each grain a triangular appearance. I cannot now remember if this appearance was equally distinct before and after immersion in glycerine: probably there was a change of shape due to osmosis. I confess that I used the word "triangular" not in its strict geometrical meaning, but in order to mark a feature which distinguished the pollen-grains of birch and hazel from those of poplar. Referring to my notes, I must admit that the shape of the grains which I identified with birch pollen would have been more accurately described as "spherical with three large protuberances." HUBERT AIRY

Blackheath, S.E., Aug. 31

Chrysomela Banksii

I SHOULD be much obliged if you would allow me to ask the following question of Coleopterists in the columns of NATURE:—

Does *Chrysomela Banksii* possess any quality, such as that of exuding an acrid liquid or the like, which would be likely to make it distasteful to spiders or other animals? I have seen it first taken and then rejected unharmed by a Trap-door Spider, and as these spiders feed largely on beetles, I am led to suppose that this particular beetle has some special protection.

J. TRAHERNE MOGGRIDGE

2, Foxton Villas, Richmond, Surrey, Aug. 27

The Aurora Borealis

MAY I ask the readers of NATURE for information on the following points:—

1. Where can I find references to any observations on the polarisation or otherwise of auroral light?

2. Are there any published lists of auroræ arranged with a view to determine the periodicity of its recurrence; or, if not so arranged, sufficiently extended for such an investigation?

3. Has any observer besides Mr. Backhouse noted the relative proportion between eastward and westward movement of auroral rays? HENRY R. PROCTER

North Shields, Aug. 29

ROBERT EDMOND GRANT, M.D., F.R.S.

ON Sunday, August 23, after an illness of about a fortnight, died Dr. R. E. Grant, for many years Professor of Zoology and Comparative Anatomy at University College, London. The family from which Dr. Grant was descended had its head-quarters in the county of Elgin, whence his father removed to Edinburgh, settling as an accountant and a writer to the signet in Argyll Square. He was one of fourteen children, twelve brothers and two sisters, being the seventh son, and the longest surviving of them all. Neither he nor any of his brothers were married; one sister was, but she left no children. He was born in 1793. Between 1803 and 1808 he was a pupil at the High School, Edinburgh, after leaving which he entered the University of that city as a medical student, attending the lectures of Drs. Monro, Hope, Gregory, Duncan, and others. He took his doctor's degree in 1814, for five years after which he devoted his time to travelling on the Continent, visiting Paris, Rome, Florence, as well as Germany, Bohemia, Hungary, and Austria. In 1822 he settled in Edinburgh, and from then till 1828 contributed several zoological papers to different Scotch scientific societies and journals, including one to the Wernerian Natural History Society, in 1827, on the circulation of fluids through the structure of sponges, in which attention was first drawn to the function of the ossicula and pores of those animals, and which led Mr. Fleming to give the generic name *Grantia* to one member of the family.

In June 1827, whilst still in Edinburgh, Dr. Grant was elected Professor of Zoology and Comparative Anatomy in the new University of London, then being formed; his first lecture was not however delivered until October 1828. For the first few years after he settled in London he communicated several papers on zoological subjects to the Scientific Committee of the Zoological Society, some of which, on points in the anatomy of *Sepiola*, *Loligopsis*, and *Beroë*, read in 1833, are to be found in the first volume of their Transactions. From that time Dr. Grant published no papers of importance.

In 1836 Dr. Grant was elected a Fellow of the Royal Society, and in 1837 he was appointed to the triennial Fullerian Professorship of Physiology at the Royal Institution in Albemarle Street.

At his classes, during one session, it is said that Dr. Grant had only two attendants, these being Mr. Hallam, the illustrious historian, and a young boy; it was always a matter of surprise to the other students of the college how he managed to adapt his lectures to the mental capacity of this trying audience.

During the forty-six years that he held his professorship, he never missed a single lecture. It was his determination, if he had lived, to resign his appointment during the present year.

In disposition Dr. Grant was very retiring and seclusive, and a great reader. He travelled much and was an excellent linguist; so fond of languages was he, that only two years ago he attended lectures on Anglo-Saxon in University College. By his will Dr. Grant leaves his extensive library and all his private collection to University College, together with a sum of money to be employed in maintaining and extending the zoological and zootomical department of the library of the college.

CONFERENCE FOR MARITIME METEOROLOGY

A GENERAL wish having of late been expressed that the measures for the prosecution of Maritime Meteorology, proposed at the International Conference at Brussels in 1853, should be reconsidered, now that the experience of more than twenty years of the operation of these measures has enabled meteorologists to form opinions as to their utility, a conference is now being held at the Meteorological Office, 116, Victoria-street, consisting of the following gentlemen:—Austria—R. Müller, K. K. Hydrographic Office, Pola. *Belgium—Van Rysselberghe, Navigation School, Ostend. Bengal—H. F. Blanford, Meteorological Office, Calcutta. China—J. D. Campbell, Secretary Commissioners of Maritime Customs. Denmark—Capt. N. Hoffmeyer, Meteorological Institute, Copenhagen. France—C. Sainte-Claire Deville, Inspector of Meteorological Stations; A. Delamarche, Ministry of Marine, Paris. Germany—W. H. von Freeden, Deutsche Seewarte, Hamburg; G. Neumayer, Hydrographer, Berlin; Capt. Stempel, Imperial Navy; H. A. Meyer, Commissioner for Investigating German Seas, Kiel. Great Britain—(Board of Trade), Capt. Toynbee; R. H. Scott, Director Meteorological Office, Hon. Sec.; *(Admiralty), Rear-Admiral Nolloth; R. J. Mann, M.D., President Meteorological Society. Holland—Buys Ballot, Royal Meteorological Institute, Utrecht, President; Lieut. J. E. Cornelissen, R.N. Italy—Capt. N. Canevaro, R.N. Norway—H. Mohn, Meteorological Institute, Christiania. Portugal—J. C. de Brito Capello, Observatory, Lisbon. Russia—Capt. M. Rikatcheff, I.R.N., Central Physical Observatory, St. Petersburg; *A. Movitz, Observatory, Tiflis. Spain—C. Pujazon, Marine Observatory, San Fernando; Captain Montijo, S.N. *Turkey—Admiral Hobart Pacha. The basis of discussion will be the Report of the Brussels Conference above referred to, with some other heads relating to instructions, instruments, &c. The Conference will be divided into two sub-committees:—1. Instruments; 2. Observations. A Report of the proceedings will be published by the Meteorological Committee. A programme has already appeared in NATURE, vol. x. p. 152.

DEEP-SEA SOUNDINGS IN THE PACIFIC OCEAN

WE take the following extracts on this subject from a report made to the United States Secretary of the Navy by Commander George E. Belknap, dated United States Steamer *Tuscarora*, Hakodadi, Japan, June 26:—

"I left Yokohama on the 8th inst., and at dawn the next morning began the work of sounding homeward on a great circle passing through the island of Tawaga, of the Aleutian group, and towards Puget's Sound. When about 100 miles east by south from Kinghasan or Sendai Bay, on the east coast of Japan, the lead sank to a depth of 3,427 fathoms, showing a descent of 1,594 fathoms in a run of 30 miles. The result seems extraordinary at so short a distance from the land, but the next coast revealed a depth still more astonishing, the sinker carrying the wire down 4,643 fathoms without reaching the bottom.

"On this occasion, when some 500 fathoms of wire had run out, the sinker was suddenly swept under the ship's bottom by the strong undercurrent, and all efforts to get the wire clear and keep it from tending underneath were unavailing, the difficulty being increased by a fresh breeze and a moderately heavy sea. Finally, when 4,643 fathoms of wire had run out, and only 150 fathoms of wire were left on the reel, it broke close to the surface, and about five miles were lost.

"The strain on the reel was very great, and notwithstanding a weight of 130 lb. on the pulley line, it took three men to check and hold the drum, and the wonder was that the wire had not parted sooner. This great strain must have been due to the action of the strong undercurrent upon the sinker, sweeping it with great force from the ship, as since that cast we have sounded repeatedly in depths of more than 4,000 fathoms, and had no trouble in reaching the bottom.

"The position of the cast, as shown by observation was about 45 miles distant from the previous one, the strong current having carried the ship beyond the position where it was intended to sound. . . .

"I determined to run back inshore and skirt the stream, beginning a new great circle off Point Komoto, in latitude 40° north. I also concluded to increase the weight of the sinker some 20 lb. . . .

"It will be seen, by an inspection of the track chart of sounding, that the moment the second line diverges from the coast of Niphon and enters the edge of the Japan stream, but yet runs parallel to the island of Yesso, the water begins to deepen rapidly, and at the cast No. 24, or the third cast from the initial point of curve, a depth of 3,493 fathoms is found. Forty and eighty miles further on depths of 3,587 fathoms and 3,307 fathoms are reached; then the ocean bed or trough of the stream drops nearly a statute mile in the run to the next position, where the sinker is not detached until it has descended to the extraordinary depth of 4,340 fathoms.

---

* Not present at the meeting on Aug. 31.

"A good specimen of bottom soil was brought up from that great depth, and the Miller's Casella thermometer, No. 18,136, came up a perfect wreck. . . . .

"The next six casts were made in over 4,000 fathoms water, the last two revealing depths of 4,411 fathoms and 4,655 fathoms respectively, and on both occasions the wire was lost. . . . .

"Sometimes the wire comes in much easier than at others, and cast No. 31, made in 4,120 fathoms, occupied only 1h. 47m. 42s.

"The difference must be due to the varying action of the undercurrents upon the rod, specimen cup, and small lead, increasing or diminishing the resistance in hauling in, according to the extent of curve from the perpendicular. . . . .

"The conditions under which all these deep casts were made were eminently favourable. Believing that such deep water would be impracticable for cable purposes, I resolved to run inshore and sound back along the coast of the Kurile Islands to the position of cast No. 22, then to return and skirt those islands and the coast of Kamschatka as far as Cape Chipounsky, then passing over to the Alutian group. . . . .

"If the time on the great circle route for the proposed cable has failed, at least for the present, the results of these soundings will be of interest and value to hydrographic science, as establishing the fact of depths in the sea hardly to be expected, in view of the numerous soundings made by her Majesty's steamship *Challenger* and this ship, over wide expanses of the Atlantic, Pacific, and Indian Oceans, and confirming the existence of a very deep trough under the Japan stream, similar to that cut by the Gulf Stream on our own coast. . . . .

"As we passed by Sturup, of the Kurile group, dense volumes of smoke were seen rising out of a crater on the east end of the island."

PROCEEDINGS OF THE FRENCH ASSOCIATION

On Sunday the 23rd there was an excursion to Boulogne, to visit the steel-pen factory established by the Blanzy Company, and the Laboratory of Zoology, which Prof. Giard of Lille has organised by the seaside. On Monday many members paid a visit to Turcoing and Roubaix, two large manufacturing places in the vicinity of Lille, where the visitors were received with much courtesy; every workshop was eagerly thrown open for inspection.

At a general session held in the evening, M. Ménier, the large chocolate manufacturer who has realised an immense fortune in his trade, delivered a very appropriate lecture on the creation of wealth by science. No one has had so much practical experience on that subject in the society. M. Alglave, formerly a professor in the Academy of Douai, gave an impressive address on coal-mining in Northern France. It was the first time that M. Alglave, who is very popular in Northern France, was allowed to deliver an address since he got into difficulties with the Government. His address created quite a sensation in the city.

On Tuesday there was a general excursion to Anzin coal-mines. A splendid luncheon was given to the visitors by the Anzin Company, in a large storehouse tastefully ornamented for the occasion with national flags and a trophy of all implements used by miners in their underground industry. M. Marsilly, the general director, proposed "The Visitors," in the name of the Council of Administration. M. Wurtz, in return, proposed "The Council and the illustrious President," whom he did not name, but who is no less a person than M. Thiers, at the mention of whose name enthusiastic cheers broke forth, interrupting M. Wurtz for more than five minutes. M. de Marsilly delivered a very long and able address, summarising all that the mining industry owed to science, and giving a few curious figures relating to his Company. It is 137 years old, and was the first French firm to import steam-engines from England. The number of hands is 15,000, and persons depending upon them 60,000. They are now constructing steam-engines, of 500 horse-power, for underground work. The society visited the Haveley pit, one of the forty belonging to the Company, whose concession covers about 100,000 acres, and is said to be worth more than 8,000,000 sterling. On the same evening M. Gaston Tissander delivered an address on aerostation specially considered as to its meteorological uses. The lecture was illustrated by diagrams showing forms of clouds, optical phenomena connected with aerostation, &c.

On Wednesday all the Sections were busy discussing the several communications, and held two sessions. M. Bergeron gave a most interesting address in the Engineering Department, on the boring of the tunnel between France and England. He said, upon authority, that the French Government had sent to Lord Derby a note asking him if he objected to the granting of the exclusive right for a number of years to a private Company. If the English Government does not raise any objection, the bill will be laid before the Versailles Assembly at the end of the present parliamentary holidays. Special provisions will be made for inundating the tunnel in case of war breaking out between the two countries. The holders of the concession can renounce their rights after spending 80,000*l.* in boring a gallery of exploration at least 1,100 ft. under the sea from low-water mark. The works are to begin on the French side as soon as the concession will have been granted. MM. Léon Say, Rothschild, André, &c. are amongst the petitioners.

There was a very sharp discussion in the Anthropological Section on some theological points which had been raised.

In the evening Col. Laussedat delivered a lecture on optical military telegraphy. Almost all the officers of the garrison were present at the lecture, which was practically illustrated by various experiments.

In the morning of Thursday the business of the Sections was transacted as on the previous day, and at one o'clock a general meeting was held in the Hôtel de Ville under the presidency of M. Wurtz. Some modifications of the by-laws and regulations of the society were unanimously adopted, and the committee was instructed to ask from the Government a decree declaring the society of public utility. This is a step necessary, according to the French laws, to give societies the right of holding properties, accepting legacies, and obtaining parliamentary grants.

M. Wurtz had directed a message to the British Association asking them to send a delegation to take part in the Lille meeting. This could not be accomplished, owing to the distance, but it ended in an exchange of telegraphic courtesies between the two societies.

The British Association being our model, it is necessary for us to study its workings, in order to adapt them as far as we can to our French circumstances and scientific peculiarities. Consequently, the committee was *instructed* not to name the opening day for the 1875 meeting before ascertaining whether it shall not coincide with the opening of the next session of the British Association.

Two cities were in competition for the 1875 meeting—Clermont Ferrand, where the Puy de Dome Observatory will be inaugurated next year; and Nantes. It was generally supposed that Clermont Ferrand would be selected, but Nantes had sent a special delegate with the power of offering the grant of a large sum of money. Clermont Ferrand is poor and has drained its exchequer in helping M. Alluard in his admirable work; consequently Nantes was all but unanimously selected. The president for the Nantes meeting (1875) will be M. d'Eichtal, a gentleman of great fortune and influence, largely connected with the railway interest, and possessed of high scientific qualifications, having been educated at the Polytechnic School. The assembly appointed M. Faye, the astronomer, to be president of the 1876 meeting, but the town where it is to be held has not been decided on. The meeting was brought to a close by a banquet given at the Hôtel de Ville, by the Mayor of the city.

The number of the members of the Association is 800; it is an excess of 200 on the number of the Lyons meeting. The ladies are very few. Madame Thureau de Villeneuve, the wife of the secretary of the Société de Navigation Ardenne, was the only lady who delivered an address. This was in the section of Geography.

The Paris papers have published very short articles on the proceedings of the Association; none have shown so much interest as the *Times*, who sent a special reporter and published long telegrams on the work of the Sections.

Lille, August 29 W. DE FONVIELLE

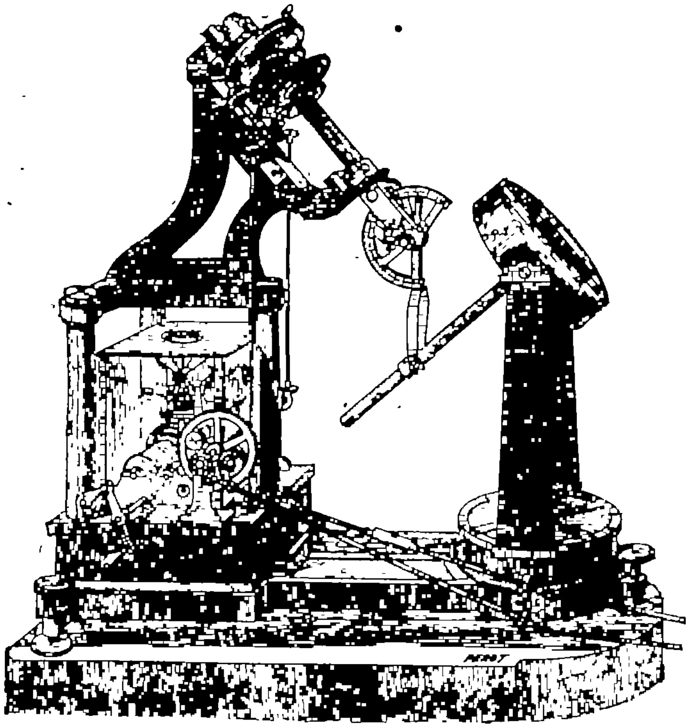


FIG. 1.—The Siderostat.

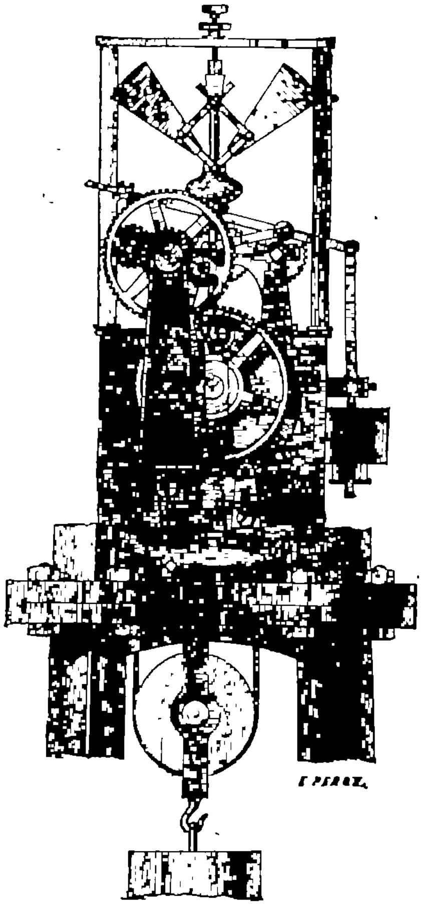


FIG. 2—Clockwork movement, with isochronous regulator

THE SIDEROSTAT [*]

THERE is in use at the present moment in the Paris Observatory an instrument of a new construction, which is destined to play a large part in the Astronomy of the future. It is not too much to say that the new instrument will play as important a part in, and will be as essential to the new Astronomy, as the transit instrument plays in the Astronomy of position.

For this instrument in its present form we are indebted to the genius of Foucault, who also gave it its name, the Siderostat.

The use of the present instruments obliges the astronomer to change his position to follow the eye-piece, and consequently to observe frequently in uncomfortable positions. To escape this inconvenience the Germans have long employed the bent telescope, meridian circles and theodolites. But the use of this arrangement is limited to small instruments, while it is precisely in the case of the largest instruments that it would be most useful.

Foucault, who died in the midst of his most important labours, wished in the latter years of his life to give to the equatorial the power of making the entire heavens pass before the observer without his having to disturb himself or to displace the instrument. A telescope fixed horizontally in an invariable position, before which a plane mirror brings successively the various points of the sky—such was the Siderostat in his mind, the idea in all probability having occurred to him from a singular employment of the heliostat by M. Laussedat in observations of the eclipse of 1860. (See Fig. 1.)

The instrument was constructed after the death of its inventor, by M. Eichens, under the direction of the Commission charged with the carrying out and the publication of the works of Foucault, and at the expense of the Imperial treasury. It was presented to the Academy of Sciences on December 13, 1869, then given by Napoleon III. to the Observatory, where it has been installed since 1872.

---

[*] In part translated from an article by M. A. Fraissinet, in *La Nature*. For the woodcuts we are indebted to the kindness of M. Gauthier-Villars.

The instrument, as designed by Foucault, of which M. Wolf has published a complete and detailed account, rests on a brass stand supported by three screws, with two levels placed crossways, and a regulating azimuth movement. There are three distinct parts—the mirror and its mounting, the polar axis and the mechanism which connects this axis with the mirror, and lastly the regulator.

The plane mirror, 30 centimetres in diameter, was constructed by M. Ad. Martin, according to the method devised by Foucault; it is carried by a horizontal axis on the top of two vertical supports, which turn round a centre. This movement is perfectly effected by means of a circle of small wheels placed at the foot of the supports. The mirror is kept in its mounting by means of cleats and spiral springs, in order to avoid all irregularity of surface. In the centre of the mounting is fixed perpendicularly a directing handle, which slides through a ring carried by a fork jointed to the lower extremity of the horary axis. The direction of the incident ray being that of the axis of the fork, and the length of this fork being equal to the distance of its point of articulation from the horizontal axis of the mirror, the line which measures that distance gives the constant direction of the reflected ray.

Finally, a clockwork movement, the isochronous regulator of Foucault (Fig. 2), placed at the foot of the instrument, communicates to the mirror a motion sensibly equal to the diurnal motion, so that the celestial bodies maintain invariable positions in the field of a horizontal telescope, in front of the apparatus directed towards the mirror.

The entire apparatus, the principle of which is the same as that of the heliostat, rests on a triangular support; a hole on the north side receives the weight which drives the clock. A wooden cabin, moving on wheels from north to south, forms a shelter for the instrument. For the purpose of observation the siderostat is completely exposed by rolling the hut towards the north. The telescope, supported on two pillars, is placed in a brick hut, some little distance from the siderostat; this hut is very slightly elevated for the purpose of intercepting the least possible portion of the southern sky. A telescope with a mirror of silvered glass, pierced in the centre to receive the eye-glass, is the one at present employed.

If it is desired to bring into the telescope the light proceeding from a star whose polar distance and right ascension are known, this is done by two circles, which correspond, the one to the polar distance and the other to the horary angle for the moment of observation in the usual way. Then, the circles being fixed, the clockwork is put in motion and the mirror throws continuously into the telescope the rays proceeding from the star under observation. The clock movement, already applied to some great equatorials, is perfectly regular, and obtained for its clever maker, M. Eichens, the grand prize in the mechanical arts at the Universal Exhibition of 1867.

It was necessary to possess, for the siderostat, some means of adjustment so as to be able to vary in very small quantities the horary angle or the polar distance without stopping the movement. The former variation is obtained by means of a subsidiary wheelwork which has already been long in use. But the variation of the polar distance was more difficult to accomplish; M. Eichens, however, has solved the difficulty after a very ingenious fashion.

The siderostat, since its construction, has been almost exclusively employed for photographic experiments in connection with the approaching transit of Venus. Consequently we do not yet know what results we have a right to look for. But in the ideal of Foucault, the instrument ought to be an indispensable auxiliary of physical astronomy; this is its proper purpose. Experiments which demand perfect steadiness will be advantageously made, such as the measure of the positions of spectrum lines and of the displacement of these lines by means of fixed spectroscopes of large dimensions. It is easy to conceive, besides, the numerous advantages resulting from the fixed direction of reflected rays. We may henceforth adapt, with the greatest ease, to the observing telescope, the apparatus necessary for the work of celestial photography for photometric researches.

The complete instrument, telescope and siderostat, placed in the plane of the meridian, may be regarded as a meridian instrument; and the determination of the right ascensions and polar distances of known stars will enable us to rectify the adjustment already made of the relation between the telescope and the siderostat. The purpose is evidently thus not to obtain a transit instrument, but only to get an approximation equal to that of equatorial observations. It is, besides, always in our power to increase the precision by comparing the star under observation with a well-known neighbouring star.

Observations by means of the siderostat may be made in two ways—with the mirror fixed, or turning under the action of the clockwork. In the former case, the instrument becomes to some extent an equatorial, but with the advantage to the observer that he has not to change his position. An inconvenience appears here; each time that the mirror is moved the direction of the apparent movement changes, and consequently it becomes necessary to make a new adjustment of the micrometer threads.

This inconvenience is more serious if, when the mirror is in motion, it is desired to effect measurements of double stars. In this case the direction of the diurnal motion changes the angles of position. It is then necessary to measure the angles of position by starting with the vertical and the horizontal, and, by means of the hour of observation, reducing them to the ordinary form.

The real defect of the siderostat, which, however, it has in common with all other instruments of observation, is that it does not enable us to examine the entire heavens. But the most interesting region for research is comprised between the pole and the southern horizon, and the siderostat which we have described permits observations between these limits. Should it be desired to investigate the rest of the sky, a second siderostat would be necessary, reflecting the rays towards the north.

Let us not, in conclusion, forget that the reflection from the mirror of the instrument causes a slight loss of light; the proportion of light reflected is constant and equal to 93-100 of the incident light for new silver.

From this description it is clear that it is only from the standpoint of physical astronomy that the employment of the instrument will be most useful; and no doubt, in this direction, it will give numerous and important results. The problems of the universe offer, indeed, a productive and inexhaustible mine, and the new astronomy, with its powerful means of investigation, gives us reason to hope that future researches will bring to light some brilliant discoveries.

NOTES

THE *Western Morning News* has received from its correspondent on board the *Challenger* an account of the voyage to New Zealand, which has been stormy and protracted. The result of the soundings has been most satisfactory, and it is confidently expected that New Zealand will be telegraphically connected with Europe next summer. The bottom was sand and mud, gradually shelving to a depth of 2,600 fathoms, at which it remained very evenly for a long distance, the temperature at this depth being 33 degrees and at the surface 64 degrees. At this point the soundings commenced getting less, and the next was found to be 1,975 fathoms (temperature 36 degrees). Two days after this 1,100 fathoms was recorded, the temperature rising to 36 degrees. These indications of shallow water were not without cause, for on the second day they came unexpectedly into 400, 350, and at last only 275 fathoms. This was about 200 miles from land. The future movements of the *Challenger* have now been arranged, and are thus stated :—At Wellington we remain till July 6, then proceed along the east coast, probably calling at Auckland for a few days, after which a course will be shaped to Tongataboo (Friendly Islands), and from thence to Kandavan (Fiji Islands), where a supply of coal will be taken on board prior to leaving for New Guinea. Here a complete series of explorations and soundings will be made, and it is expected that the dredge and trawl will bring even greater wonders of marine life to the surface than have yet been secured, while the question of coral reefs and their history will have special attention. After cruising about Polynesia generally for some time, we expect to reach Hong Kong early in November, where probably a month will be spent in coaling, provisioning, refitting, &c.

THE last number of Petermann's *Mittheilungen* contains a summary of the recent work done by the *Challenger* Expedition, which is accompanied by an excellent and ingeniously constructed series of coloured diagrams, showing the distribution of temperature in the North and South Atlantic, as well as the configuration of the bottom over which the *Challenger* has sailed. The number also contains the continuation of Prof. Hans Hofer's paper on the structure of Novaya Zemlya.

THE growth of tea and sugar in European soil are perhaps branches of culture which we can scarcely expect to be remunerative in a commercial point of view. Be this as it may, the sugar-cane is now grown and sugar manufactured to some extent in the neighbourhood of Malaga, Spain. Tea has also been introduced into the southern districts of Sicily, and though the first attempt made last year to raise the plants on a large scale was not successful, owing, it is said, to the injury caused to the plants and seeds by immersion in sea-water on their transit from Japan, it is confidently hoped and believed by the promoters that another attempt with healthy seeds and plants will prove quite successful. Meanwhile tea is being grown at the Cinchona plantations in Jamaica, and a sample has recently been received at the Kew Museum which was grown and manufactured as above from Assam tea plants received through Kew in 1868. So far as the appearance of the sample is concerned, it is roughly manipulated, not being sufficiently twisted or curled, and apparently not sufficiently roasted. Nevertheless, its manufacture is little inferior to that of the earliest samples of Assam tea that appeared in the English market. Its quality, however, is another thing, for it produces a very watery infusion of a very herby flavour, and devoid of the aroma for which tea is noted. Care, however, in the cultivation of the plant, as well as in the selection and manipulation of the leaves, may in time produce a more marketable article.

THE Ochro (*Abelmoschus esculentus*), a Malvaceous plant, is well known in all tropical countries, being cultivated for the sake of its fruits, which are gathered in a green state, and either boiled and eaten as a vegetable, pickled in vinegar like capers, or used for thickening soups on account of the mucilage they contain—a common property of the Malvaceæ. In India the seeds are sometimes boiled for making a mucilaginous drink. But we now learn that a fine oil has recently been discovered in them of a quality equal to olive oil, and that it is intended to introduce this oil to commerce. Supposing the oil to be all that is said about it, the question arises as to the supply of seeds. Though the plant is easily cultivated, can it compete with other oleaginous plants?

WE some time since noticed the formation, in connection with the French Geographical Society, of a Commission of Commercial Geography. Under the patronage of this Commission a joint stock company has been formed for the publication of a weekly journal to assist in carrying out the objects aimed at by the Commission. The title of the journal will be *L'Explorateur, Journal Géographique et Commercial*.

EXPERIMENTAL verifications are becoming daily more numerous in favour of the view that the phenomena attending the electrical stimulation of the brain are, in reality, dependent on the indirect excitation of the cerebral basal ganglionic centres by the currents employed. Besides the observations of Dr. Sanderson on this point, already published in this journal (NATURE, vol. x. p. 245), Dr. J. J. Putnam has recorded the results attending electrical stimulation of the so-called surface-centres after their almost complete separation from the rest of the hemisphere in the form of flaps. He finds that under these circumstances no movements follow the excitation; but that if the flap is raised and the surface below it irritated, a current slightly more powerful than the minimal required in the uninjured condition produces exactly similar results. The details of these experiments, taken from the *Boston Medical and Surgical Journal*, will be found in the *London Medical Record* for last week.

THERE has been issued from the Standards Department, by Mr. H. W. Chisholm, an account of the comparisons at that department between two Russian pendulums and Repsold's scale of 21 old French inches, and between Repsold's scale and the standard subdivided imperial yard.

THE French Geological Society has decided upon holding its next meeting at Mons, in Belgium, a most interesting place for excursions. It is very seldom that French Scientific Societies meet in a foreign land.

ON Friday evening M. Flammarion, the French astronomer, started from La Villette gas-works, Paris, in a balloon called *Lumen*, at half-past seven, with a brisk breeze from the north-west. The balloon was under the guidance of M. Jules Godard, and M. Flammarion, who was married in the beginning of August, was on board with his young wife; he wishes to spend his *lune de miel* in Italy. Such a trip was proposed in the beginning of the century to the celebrated Mdme. de Stael by the great philosopher, Saint-Simon; but the lady declined. The moon was full and bright.

THE use of carrier pigeons for press purposes is on the increase, and the breed is rapidly improving. By careful "selection" and allowing only the "survival of the fittest," powers have been developed which a few years ago would have been thought impossible. They can be specially trained to fly over 500 miles, and it is no uncommon thing for despatches to be brought to London from Paris, Lisbon, or Brussels. *Land and Water* records a case of interest. An ocean homing bird, of great docility, intelligence, and spirit, has been found in Iceland which flies at the meteor-like speed of 150 miles an hour. A pair of these birds whose present home is in Kent, within ten miles of London, recently carried despatches from Paris to their home in one hour and a quarter. Press pigeons carried on the despatches to London, and the whole journey of the despatches from Paris to London occupied only one hour and a half. The press pigeons now commonly used are not the ordinary carrier pigeons, but are bred by Messrs. Hartley, of Woolwich, from prize birds selected from the best lofts of Antwerp, Brussels, and Liege.

AN alarming shock of earthquake was felt in the island of Porto Rico on the morning of Aug. 26, at 6.15 A.M. The vibration lasted two minutes. No report of the extent of damage done has yet been received.

An eruption broke out in Mount Etna on Sunday evening last. The lava issued from the crater by three mouths, all of which, however, are happily some distance from human habitations.

The *Times of India* states that the report which M. Victor de Lesseps and Mr. C. Stuart will have to make on their return to Europe on the feasibility of the great Central Asian Railway scheme will be of a character to render it likely that preliminary funds will be subscribed to enable the first surveys to be effected with a view to definitely settle the route which it would be desirable to follow.

We have received from Mr. Stanford the Alpine Club Map of Switzerland, edited by Mr. R. C. Nichols, the preparation of which we noticed in vol. vi. p. 205. It is a very fine specimen of map making, and a credit to English cartography. We hope soon to notice it in detail.

If the observations recorded by Mr. F. M. Balfour at the recent meeting of the British Association, on the development of the notocord from the hypoblastic, instead of the mesoblastic layer of the embryo in the shark, are confirmed, they will shake to the foundation the importance of the elaborate arguments which have been, of late, so frequently based upon the origin of the different morphological elements of the living frame.

We are sure many of the recent visitors to Belfast must have found an invaluable aid in their wanderings about the town and district, which so abounds in varied interest, in the very excellent "Guide to Belfast and the Adjacent Counties" (Belfast, Ward and Co.), which has been brought out under the care of the members of the Belfast Naturalists' Field Club. Great prominence is of course given to the scientific aspects of the districts embraced in the Guide, but a fair portion is also devoted to the ordinary objects of interest, to trade, commerce, manufactures, &c. The Guide is well arranged under the various headings of Physical Geography, Geology, Botany, Zoology, Topography, &c., and is amply illustrated with forty-six roughly executed but very useful plates, mostly of objects of antiquarian interest. We heartily recommend the book to any visitor who wants an intelligent guide to the counties of Down and Antrim, a good map of which is appended.

The additions to the Zoological Society's Gardens during the past week include a Cassowary (*Casuarius ?*) from N.E. New Guinea, presented by Capt. Maisby; a Javan Chevrotain (*Tragulus javanicus*) from Java, presented by Mr. G. Mannings; a Formosan Deer (*Cervus pseudaxis*) from the Island of Formosa, presented by Mr. Abel A. J. Gower; two Black Swans (*Cygnus atratus*) from Australia, presented by Mr. R. H. Bower; an Indian Python (*Python molurus*); a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. C. Hassam; two Black-eared Marmosets (*Hapale penicillata*) from Brazil, presented by Mr. J. P. Harrison.

THE BRITISH ASSOCIATION

THE Belfast Session of the British Association was brought to a conclusion on Wednesday, the 26th ult., with mutual congratulations between all concerned. In our animadversions on the high charges for sleeping accommodation charged from some of the members of the Association, we of course meant in no way to reflect on the local authorities or local committee, who exerted themselves to the utmost to render the meeting in every way a success. The vote of thanks to the Mayor was thoroughly deserved, as was also the tribute of praise awarded by the Rev. Dr. Henry to the "unflagging zeal" of Dr. Andrews in behalf of this meeting of the Association. One very pleasing result of the meeting, and of a discussion in the Economical Section, was the sudden termination of the extensive strike which had existed in Belfast for a considerable time. The various excursions organised on Thursday were a decided success.

The next meeting opens at Belfast on August 25, 1875.

The Committee, among other things, have recommended, and their recommendation has been adopted, that the Council of the Association be requested to take such steps as they may think expedient to urge upon the Government of India the desirableness of continuing solar observations; that the Council of the Association be requested to take such steps as they may think desirable with the view of appointing naturalists to vessels engaged on coasts of little-known parts of the world; that they be requested to take such steps as they may think desirable to promote any application that may be made to her Majesty's Government by the Royal Society to promote physiological and biological explorations in the seas round the British Isles; that they be requested to take such steps as they think desirable for supporting a request to her Majesty's Government to undertake an Arctic expedition on the basis proposed by the Council of the Royal Geographical Society at the beginning of the present year, and which will be made again by that body.

The following is a synopsis of grants of money appropriated to scientific purposes by the General Committee at the Belfast Meeting:—

MATHEMATICS AND PHYSICS.	
*Cayley, Prof.—Printing Mathematical Tables ...	£100
*Balfour Stewart, Prof.—Magnetisation of Iron	20
*Brooke, Mr.—British Rainfall	120
*Glaisher, Mr. J.—Luminous Meteors	30
Maxwell, Prof. C.—Testing the Exactness of Ohm's Law	50
Stokes, Prof.—Reflective Power of Silver and other Substances	20
*Herschel, Prof.—Thermal Conducting Powers of Rocks	10
*Tait, Prof.—Thermo-Electricity (renewed)	50
CHEMISTRY.	
*Williamson, Prof. A. W.—Records of the Progress of Chemistry	100
Roscoe, Prof.—Specific Volumes of Liquids .. .	25
Allen, Mr.—Estimation of Potash and Phosphoric Acid	10
*Armstrong, Dr.—Isomeric Cresols and their Derivatives (renewed)	20
GEOLOGY.	
*Willett, Mr. H.—The Sub-Wealden Exploration ...	100
*Lyell, Sir C., Bart.—Kent's Cavern Exploration ...	100
*Lubbock, Sir J.—Exploration of Victoria Cave, Settle...	50
*Bryce, Dr.—Earthquakes in Scotland (renewed) ...	20
Hull, Prof.—Underground Waters in New Red Sandstone and Permian	10
BIOLOGY.	
Dresser, Mr.—Report on Ornithology	10
Rolleston, Prof.—Development of Myxinoid Fishes ..	20
*Stainton, Mr.—Record of the Progress of Zoology ...	100
*Fox, Col. Lane.—Forms of Instruction for Travellers .	20
*Brunton, Dr.—The Nature of Intestinal Secretion ...	20
GEOGRAPHY.	
Wilson, Major.—Palestine Exploration Fund	100
STATISTICS AND ECONOMIC SCIENCE.	
*Houghton, Lord.—Economic Effects of Trades' Unions	25
MECHANICS.	
Froude, Mr.—Instruments for Measuring the Speed of Ships (renewed)	50
Total	£1,180

* Reappointed.

ON THE HYPOTHESIS THAT ANIMALS ARE AUTOMATA, AND ITS HISTORY*

AT this period of the meeting of the British Association I am quite sure it is hardly necessary for me to call to your minds the nature of the business which takes place at our sectional meetings. We there register the progress which science has made during the past year, and we do our best to advance that progress by original communications and free discussion. But when the honourable task of delivering this evening's lecture was imposed upon me, or rather as my friend the President has just said, when I undertook to deliver it, it occurred to me that the occasion of an evening lecture might be turned to a different purpose, that we might with much propriety and advantage turn our minds back to the past to consider what had been done by the great men of old, who "had gone down into the grave with their weapons of war," but who had fought bravely for the cause of truth while they yet lived—to recognise their merits, and to show ourselves duly grateful for their services. I propose, therefore, to take a retrospect of the condition of that branch of science with which it is my business to be more or less familiar—not to a very remote period, for I shall go no further back than the seventeenth century, and the observations which I shall have to offer you will be confined almost entirely to the biological science of the time between the middle of the seventeenth and the middle of the eighteenth centuries. I propose to show what great ideas in biological science took their origin at that time, in what manner the speculations then originated have been developed, and in what relation they stand to what is now understood to be the body of scientific biological truth. The middle of the sixteenth century, or rather the early part of it, is one of the great epochs of biological science. It was at that time that an idea, which had been dimly advocated previously, took the solid form which can only be given to scientific ideas by the definite observation of fact—I mean the idea that vital phenomena, like all other phenomena of the physical world, are capable of mechanical explanation, that they are reducible to law and order, and that the study of biology, in the long run, is an application of the great sciences of physics and chemistry. The man to whom we are indebted for first bringing that idea into a plain and tangible shape, I am proud to say, was an Englishman, William Harvey. Harvey was the first clearly to explain the mechanism of the circulation of the blood, and by that remarkable discovery of his, and by the clearness and precision with which he reduced that process to its mechanical elements, he laid the foundation of a scientific theory of the larger part of the processes of living beings—those processes, in fact, which we now call processes of sustentation—and by his studies of development he, further, first laid the foundation of a scientific knowledge of reproduction. But besides these great powers of living beings, there remains another class of functions—those of the nervous system—with which Harvey did not grapple. It was, indeed, left for a contemporary of his, a man who, as he himself tells us, was mainly stimulated in these inquiries by the brilliant researches of Harvey—Réné Descartes—to play a part in relation to the phenomena of the nervous system, which, in my judgment, is equal in value to that which Harvey played in regard to the circulation. And when we consider who Descartes was, how brief the span of his life, I think it is a truly wonderful circumstance that this man, who died at fifty-four, should be one of the recognised leaders of philosophy—that, as I am informed by competent authority, he was one of the first and most original mathematicians who has ever lived, and that, at the same time, the fertility of his intellect and the grasp of his genius should have been so great that he could take rank, as I believe he must, beside the immortal Harvey as a physiologist. And you must recollect that Descartes was not merely, as some had been, a happy speculator. He was a working anatomist and physiologist, conversant with all the anatomical and physiological lore of his time, and practised in all methods by which anatomical and physiological discoveries were then made; and it is related of him—and a most characteristic anecdote it is, and one which should ever put to silence those shallow talkers who speak of Descartes as a merely hypothetical and speculative philosopher—that a friend once calling upon him in Holland begged to be shown his library. Descartes led him into a sort of shed, and, drawing aside a curtain, displayed a dissecting-room full of bodies of animals in course of dissection, and said, "There is my library." It would take us a very long time if I were to attempt to pursue the method which would be requisite for the full establishment of all that I am about to say; that is to say, if I were to quote the several passages of Descartes's works which bear out my ascription to him of the several propositions which I am going to bring before you. And I must beg you, therefore, to be so good as to take it on my authority for the present, although for the present only, that there are to be found clearly expressed in Descartes' works the propositions which I shall proceed to lay before you, and each of which I shall compare as we go on, as briefly as may be, with the existing state of physiological science, in order that you may see in what position with respect to physiology—ay, even to the advanced physiology of the present time—this man stood. And, happily, the matters with which we shall treat are such as to require no extensive knowledge of anatomy—no more, in fact, than such as, I presume, must be familiar to almost every person.

I think I need only premise that what we call the nervous system in one of the higher animals consists of a central apparatus, composed of the brain, which is lodged in the skull, and of a cord proceeding from it, which is termed the spinal marrow, and which is lodged in the vertebral column or spine, and that from these soft white masses—for such they are—there proceed cords which are termed nerves, some of which nerves end in the muscles, while others end in the organs of sensation. That bare and bald statement of the fundamental composition of the nervous system will be enough for our present purpose.

The first proposition culled from the works of Descartes which I have to lay before you, is one which will sound very familiar. It is the view, which he was the first, so far as I know, to state, not only definitely, but upon sufficient grounds, that the brain is the organ of sensation, of thought, and of emotion—using the word "organ" in this sense, that certain changes which take place in the matter of the brain are the essential antecedents of those states of consciousness which we term sensation, thought, and emotion. Nowadays that is part of popular and familiar knowledge. If your friend disagrees with your opinion, runs amuck against any of your pet prejudices, you say, "Ah! poor fellow, he is a little touched here;" by which you mean that his brain is not doing its business properly, and, therefore, that he is not thinking properly. But in Descartes' time, and I may say for 150 years afterwards, the best physiologists had not reached that point. It remained down to the time of Bichat a question whether the passions were or were not located in the abdominal viscera. Thus, therefore, was a very great step. It is a statement which Descartes makes from the beginning, and from which he never swerves. In the second place, Descartes lays down the proposition that all the movements of animal bodies are effected by the change of form of a certain part of the matter of their bodies, to which he applies the general term of muscle. You must be aware of this in reading Descartes; you must use the terms in the sense in which he used them, or you will not understand him. That is a proposition which is now placed beyond all doubt whatever. If I move my arm, that movement is due to the change of this mass of flesh in front called the biceps muscle: it is shortened and it becomes thicker. If I move any of my limbs, the reason is the same. As I now speak to you, the different tones of my voice are due to the exquisitely accurate adjustment of the contractions of a multitude of such portions of flesh; and there is no considerable and visible movement of the animal body which is not, as Descartes says, resolvable into these changes in the form of matter termed muscle. But Descartes went further, and he stated that in the normal and ordinary condition of things, these changes in the form of muscle in the living body only occur under certain conditions; and the essential condition of the change is, says Descartes, the motion of the matter contained within the nerves, which go from the central apparatus to the muscle. Descartes gave this moving material a particular name—the animal spirits. Nowadays we should not talk of the existence of animal spirits, but we should say that a molecular change takes place in the nerve, and that that molecular change is propagated with a certain velocity, from the central apparatus to the muscle. Nevertheless, the modification of the idea is not greater than that which has taken place in our view of electricity, in our change of conception of it as a fluid to our conception of it as a condition of propagated molecular change. Modern physiology has measured the rate of the change to which I have referred; it has thrown marvellous light upon its nature; it has increased our knowledge of its characters, but the fundamental conception remains exactly what it was in the time of Descartes. Next, Descartes says that, under ordinary circumstances, this change in the contents of a nerve, which gives rise to the contraction of a muscle, is produced by a change in the central nervous apparatus, as, for example, in the brain. We say at the present time exactly the same thing. Descartes said that the animal spirits were stored up in the brain, and flowed out along the motor nerves. We say that a molecular change takes place in the brain that is propagated along the motor nerve. The evidence of that is abundantly supplied by experimental research. Further, Descartes stated that the sensory organs, or those apparatuses which give rise to our feelings when acted upon by the influences which produce sensation, caused a change in the sensory nerves, which he described as a flow of animal spirits along those nerves, which flow was propagated to the brain. If I look at this candle which I hold before me, the light falling on the retina of my eye gives rise to an affection of the optic nerve, which affection Descartes described as a flow of the animal spirits to the brain. We should now speak of it as a molecular change propagated along the optic nerve to the brain; but the fundamental idea is the same. In all our notions of the operations of nerve we are building upon Descartes' foundation. Not only so, but Descartes lays down over and over again, in the most distinct manner, a proposition which is of paramount importance not only for physiology but for psychology. He says that when a body which is competent to produce a sensation touches the sensory organs, what happens is the production of a mode of motion of the sensory nerves. That mode of motion is propagated to the brain. That which takes place in the brain is still nothing but a mode of motion. But, in addition to this mode of motion, there is, as everybody can find by experiment for himself, something else which can in no way be compared to motion, which is utterly unlike it, and which is that state of consciousness which we call a sensation. Descartes insists over and over again upon this total disparity between the agent which excites the state of consciousness and the state of consciousness itself. He tells us that our sensations are not pictures of external things, but that they are symbols or signs of them; and in doing that he made one of the greatest possible revolutions, not only in physiology but in philosophy. Till his time it was conceived that visible bodies, for example, gave from themselves a kind of film which entered the eye and so went to the brain, *species intentionales* as they were called, and thus the mind received an actual copy or picture of things which were given off from it. It is to Descartes we owe that complete revolution in our ideas, which has led us to see that we have really no knowledge whatever of the causes of those phenomena which we term external things, and that the only certainty we possess is that they cannot be like those phenomena. In laying down that proposition upon what I imagine to be a perfectly irrefragable basis, Descartes laid the foundation of that form of philosophy which is termed idealism, which was subsequently expanded to its uttermost by Berkeley, and has since taken very various shapes.

---

* Address by Prof. Huxley, F.R.S., at the British Association, Belfast, Aug. 24.

But Descartes noticed not only that under certain conditions an impulse made by the sensory organ may give rise to a sensation, but that under certain other conditions it may give rise to motion, and that this motion may be effected without sensation, and not only without volition, but even contrary to it. I trouble you with as little reading as I can, because it occupies so much time; but I must ask your patience for one very remarkable passage which is contained in the answer that Descartes gave to the objections raised by the famous Port Royalist Arnauld to his Fourth Meditation. Descartes says: "It appears to me to be a very remarkable circumstance that no movement can take place either in the bodies of beasts or even in our own, if these bodies have not in themselves all the organs and instruments by means of which the very same movement would be accomplished in a machine, so that, even in us, the spirit or the soul does not directly move the limb, but only determines the course of that very subtle liquid which is called the animal spirits, which, running continually from the heart by the brain into the muscles, is the cause of all the movements of our limbs, and often may cause many different motions, one as easily as the other. And it does not even always exert this determination, for, among the movements which take place in us, there are many which do not depend upon the mind at all, such as the beating of the heart, the digestion of food, the nutrition, the respiration of those who sleep, and, even in those who are awake, walking, singing, and other similar actions when they are performed without the mind thinking about them. And when one who falls from a height throws his hands forward to save his head, it is in virtue of no ratiocination that he performs this action; it does not depend upon his mind, but takes place merely because his senses, being affected by the present danger, cause some change in his brain, which determines the animal spirits to pass thence into the nerves in such a manner as is required to produce this motion, in the same way as in a machine, and without the mind being able to hinder it." I know in no modern treatise of a more clear and precise statement, of a more perfect illustration than this of what we understand by the automatic action of the brain. And what is very remarkable, in speaking of these movements which arise by a sensation being as it were reflected from the central apparatus into a limb—as, for example, when one's finger is pricked and the arm is suddenly drawn up, the motion of the sensory nerve travels to the spine and is again reflected down to the muscles of the arm—Descartes uses the very phrase that we at this present time employ; he speaks of the "*esprits réfléchis*," the reflected spirits; and that this was no mere happy phrase lost upon his contemporaries will be obvious if you consult the famous work of Willis, the Oxford professor, "De Anima Brutorum," which was published about 1672. In giving an account of Descartes' views he borrows this very phrase from him, and speaks of this reflection of the motion of a sensory nerve into the motion of a motor nerve, "sicut undulatione reflexa," as if it were a wave thrown back; so that we have not only the thing reflex action described, but we have the phrase "reflex" recognised in its full significance.

And the last great service to the physiology of the nervous system which I have to mention as rendered by Descartes was this, that he first, so far as I know, sketched out a physical theory of memory. What he tells you in substance is this, that when a sensation takes place, the animal spirits travel up the sensory nerve, pass to the appropriate part of the brain, and there, as it were, find their way through the pores of the substance of the brain. And he says that when this has once taken place, when the particles of the brain have themselves been, as it were, shoved aside a little by a single passage of the animal spirits, the passage is made easier in the same direction for any subsequent flow of animal spirits; and that the repetition of this action makes it easier still, until, at length, it becomes very easy for the animal spirits to move these particular particles of the brain, the motion of which gives rise to the appropriate sensation; and, finally, the passage is so easy that almost any impulse which stirs the animal spirits causes them to flow into these already open pores more easily than they would flow in any other direction; and the flow of the animal spirits recalls the image, the state of consciousness called into existence by a former sensory impression. This view is essentially at one with all our present physical theories of memory. That memory is dependent upon a physical process stands beyond question. The results of the study of disease, the results of the action of poisonous substances, all conclusively point to the fact that memory is inseparably connected with the integrity of certain material parts of the brain and dependent upon them, and I know of no hypothesis by which this fact can be accounted for except by one which is essentially similar to the notion of Descartes, a notion that the impression once made makes subsequent impressions easier and therefore allows almost any indirect disturbance of the brain to call up this particular image.

So far, the ideas started by Descartes have simply been expanded, enlarged, and defined by modern research; they are the keystones of the modern physiology of the nervous system. But in one respect Descartes proceeded further than any of his contemporaries, and has been followed by very few of his successors in later days, although his views were for the best part of a century largely dominant over the intellectual mind of Europe. Descartes reasoned thus: "I can account for many of the actions of living beings mechanically, since reflex actions take place without the intervention of consciousness, and even in opposition to the will." As, for example, when a man in falling mechanically puts out his hand to save himself, or when a person, to use another of Descartes' illustrations, strikes at his friend's eye, and although the friend knows he does not mean to hit him; he nevertheless cannot prevent the muscles of his eye from winking. "In these cases," Descartes said, "I have clear evidence that the nervous system acts mechanically without the intervention of consciousness and without the intervention of the will, or, it may be, in opposition to it. Why, then, may I not extend this idea further? As actions of a certain amount of complexity are brought about in this way, why may not actions of still greater complexity be so produced? Why, in fact, may it not be that the whole of man's physical actions are mechanical, his mind living apart, as it were, and only occasionally interfering by means of volition?" And it so happened that Descartes was led by some of his speculations to believe that beasts had no souls, and consequently could have no consciousness; and thus, his two ideas harmonising together, he developed that famous hypothesis of the automatism of brutes, which is the main subject of my present discourse. What Descartes meant by this was that animals are absolute machines, as if they were mills or barrel organs; that they have no feelings; that a dog does not see, and does not hear, and does not smell, but that the impressions which would produce those states of consciousness in ourselves, give rise in the dog, by a mechanical reflex process, to actions which correspond to those which we perform when we do smell, and do taste, and do see. On the face of it this appears to be a most surprising hypothesis, and I do not wonder that it proved to be a stumbling-block even to such acute and subtle men as Henry More, who was one of Descartes' correspondents; and yet it is a very singular thing that this, the boldest and most paradoxical notion which Descartes broached, has received as much and as strong support from modern physiological research as any other of his hypotheses. I will endeavour to explain to you in as few words as possible what is the nature of that support, and why it is that Descartes' hypothesis, although I am bound to say I do not agree with it, nevertheless, remains at this present time not only quite as defensible as it was in his own time, but I should say, upon the whole, a little more defensible.

If it should happen to a man that by accident his spinal cord is divided, he would become paralysed below the point of injury. In such case his limbs would be absolutely paralysed; he would have no control over them, and they would be devoid of sensation. You might prick his feet, or burn them, or do anything else you like with them, and they would be absolutely insensible. Consciousness, therefore, so far as we can have any knowledge of it, would be entirely abolished in that part of the central nervous apparatus which lies below the injury. But although the man under these circumstances is paralysed in the sense of not being able to move his own limbs, he is not paralysed in the sense of their being deprived of motion, for if you tickle the soles of his feet with a feather the limbs will be drawn up just as vigorously, perhaps a little more vigorously, than when he was in full possession of the consciousness of what happened to him. Now, that is a reflex action. The impression is transmitted from the skin to the spinal cord, it is reflected from the spinal cord, and passes down into the muscles of the limbs, and they are dragged up in this manner—dragged away from the sources of irritation, though the action, you will observe, is a purely automatic or mechanical action. Suppose we deal with a frog in the same way, and cut across the spinal cord. The frog falls into precisely the same condition. So far as the frog is concerned, his limbs are useless; but you have merely to apply the slightest irritation to the skin of the foot, and the limb is instantly drawn away. Now, if we have any ground for argument at all, we have a right to assume that, under these circumstances, the lower half of the frog's body is as devoid of consciousness as is the lower half of the man's body; and that the body of the frog below the injury is in this case absolutely devoid of consciousness, is a mere machine like a musical box or a barrel-organ, or a watch. You will remark, moreover, that the movement of the limbs is purposive—that is to say, that when you irritate the skin of the foot, the foot is drawn away from the danger, just as it would be if the frog were conscious and rational, and could act in accordance with rational consciousness. But you may say it is easy enough to understand how so simple an action might take place mechanically.

Let us consider another experiment. Take this creature, which certainly cannot feel, and touch the skin of the side of the body with a little acetic acid, a little vinegar, which in a frog that could feel would give rise to great pain. In this case there can be no pain, because the application is made below the point of section; nevertheless, the frog lifts up the limb of the same side, and applies the foot to rubbing off the acetic acid; and, what is still more remarkable, if you hold down the limb so that the frog cannot use it, he will, by and by, take the limb of the other side and turn it across the body, and use it for the same rubbing process. It is impossible that the frog, if it were in its entirety and were reasoning, could perform actions more purposive than these, and yet we have most complete assurance that in this case the frog is not acting from purpose, has no consciousness, is a mere automatic machine. But now suppose that instead of making your section of the cord in the middle of the body, you had made it in such a manner as to divide the hindermost part of the brain from the foremost part of the brain, and suppose the foremost two-thirds of the brain entirely taken away, the frog is then absolutely devoid of any spontaneity; it will remain for ever where you leave it; it will not stir unless it is touched; it sits upright in the condition in which a frog habitually does sit; but it differs from the frog which I have just described in this, that if you throw it into the water it begins to swim—swims just as well as the perfect frog does. Now, swimming, you know, requires the combination, and indeed the very careful and delicate combination, of a great number of muscular actions, and the only way we can account for this is, that the impression made upon the sensory nerves of the skin of the frog by the contact of the water, conveys to the central nervous apparatus a stimulus which sets going a certain machinery by which all the muscles of swimming are brought into play in due order and succession. Moreover, if the frog be stimulated, be touched by some irritating body, although we are quite certain it cannot feel, it jumps or walks as well as the complete frog can do. But it cannot do more than this.

Suppose yet one other experiment. Suppose that all that is taken away of the brain is what we call the cerebral hemispheres, the most anterior part of the brain. If that operation is properly performed, the frog may be kept in a state of full bodily vigour for months, or it may be for years; but it will sit for ever in the same spot. It sees nothing; it hears nothing. It will starve sooner than feed itself, although if food is put into its mouth it swallows it. On irritation it jumps or walks; if thrown into the water it swims. But the most remarkable thing that it does is this—you put it in the flat of your hand; it sits there, crouched, perfectly quiet, and would sit there for ever. Then if you incline your hand, doing it very gently and slowly, so that the frog would naturally tend to slip off, you feel the creature's fore-paws getting a little slowly on to the edge of your hand until he can just hold himself there, so that he does not fall; then, if you turn your hand, he mounts up with great care and deliberation, putting one leg in front and then another, until he balances himself with perfect precision upon the edge of your hand; then if you turn your hand over, he goes through the opposite set of operations until he comes to sit in perfect security upon the back of your hand. The doing of all this requires a delicacy of co-ordination, and an adjustment of the muscular apparatus of the body which is only comparable to that of a rope-dancer among ourselves; though in truth a frog is an animal very poorly constructed for rope-dancing, and on the whole we may give him rather more credit than we should to a human dancer. These movements are performed with the utmost steadiness and precision, and you may vary the position of your hand, and the frog, so long as you are reasonably slow in your movements, will work backwards and forwards like a clock. And what is still more wonderful is, that if you put the frog on a table, and put a book between him and the light, and give him a little jog behind, he will jump—take a long jump, very possibly—but he won't jump against the book; he will jump to the right or to the left, but he will get out of the way, showing that although he is absolutely insensible to ordinary impressions of light, there is still a something which passes through the sensory nerve, acts upon the machinery of his nervous system, and causes it to adapt itself to the proper action.

Can we go further than this? I need not say that since those days of commencing anatomical science when criminals were handed over to the doctors, we cannot make experiments on human beings, but sometimes they are made for us, and made in a very remarkable manner. That operation called war is a great series of physiological experiments, and sometimes it happens that these physiological experiments bear very remarkable fruit. I am indebted to my friend General Strachey for bringing to my notice an account of a case which appeared within the last four or five days in the scientific article of the *Journal des Débats*. A French soldier, a sergeant, was wounded at the battle of Bazeilles, one, as you recollect, of the most fiercely contested battles of the late war. The man was shot in the head, in the region of what we call the left parietal bone. The bullet fractured the bone. The sergeant had enough vigour left to send his bayonet through the Prussian who shot him. Then he wandered a few hundred yards out of the village, fell senseless, but, after the action, was picked up and taken to the hospital, where he remained some time. When he came to himself, as usual in such cases of injury, he was paralysed on the opposite side of the body, that is to say, the right arm and the right leg were completely paralysed. That state of things lasted, I think, the better part of two years, but sooner or later he recovered from it, and now he is able to walk about with activity, and only by careful measurement can any difference between the two sides and his body be ascertained. The inquiry, the main results of which I shall give you, has been conducted by exceedingly competent persons, and they report that at present this man lives two lives, a normal life and an abnormal life. In his normal life he is perfectly well, cheerful, does his work as a hospital attendant, and is a respectable, well-conducted man. This normal life lasts for about seven-and-twenty days, or thereabouts, out of every month; but for a day or two in each month he passes suddenly and without any obvious change into his abnormal condition. In this state of abnormal life he is still active, goes about as usual, and is to all appearance just the same man as before, goes to bed and undresses himself, gets up, makes his cigarette and smokes it, and eats and drinks. But he neither sees, nor hears, nor tastes, nor smells, nor is he conscious of anything whatever, and he has only one sense organ in a state of activity, namely, that of touch, which is exceedingly delicate. If you put an obstacle in his way, he knocks against it, feels it and goes to the one side; if you push him in any direction, he goes straight on until something stops him. I have said that he makes his cigarettes, but you may supply him with shavings or of anything else instead of tobacco, and still he will go on making his cigarettes as usual. His actions are purely mechanical. He feeds voraciously, but whether you give him aloes or assafoetida, or the nicest thing possible, it is all the same to him. The man is in a condition absolutely parallel to that of the frog I have just described, and no doubt when he is in this condition the functions of his cerebral hemispheres are, at any rate, largely annihilated. He is very nearly—I don't say wholly, but very nearly—in the condition of an animal in which the cerebral hemispheres are extirpated. And his state is wonderfully interesting to me, for it bears on the phenomena of mesmerism, of which I saw a good deal when I was a young man. In this state he is capable of performing all sorts of actions on mere suggestion. For example, he dropped his cane, and a person near him putting it into his hand, the feeling of the end of the cane evidently produced in him those molecular changes of the brain which, had he possessed consciousness, would have given rise to the idea of his rifle; for he threw himself on his face, began feeling for his cartridges, went through the motions of touching his gun, and shouted out to an imaginary comrade, "Here they are, a score of them; but we will give a good account of them." But the most remarkable fact of all is the modification which this injury has made in the man's moral nature. In his normal life he is an upright and honest man. In his abnormal state he is an inveterate thief. He will steal everything he can lay his hands upon, and if he cannot steal anything else, he will steal his own things and hide them away.

Now, if Descartes had had this fact before him, need I tell you that his theory of animal automatism would have been enormously strengthened? He would have said: "Here is a case of a man performing actions more complicated, and to all appearance more dependent on reason, than any of the ordinary operations of animals, and yet you have positive proof that these actions are purely mechanical. What, then, have you to urge against my doctrine that all animals are mere machines?" In the words of Malebranche, who adopted Descartes' view, "In dogs, cats, and other animals, there is neither intelligence nor spiritual soul as we understand the matter commonly; they eat without pleasure, they cry out without pain, they grow without knowing it, they desire nothing, they know nothing, and if they act with dexterity and in a manner which indicates intelligence, it is because God having made them with the intention of preserving them, He has constructed their bodies in such a manner that they escape organically, without knowing it, everything which could injure them and which they seem to fear." Descartes put forward this hypothesis, and I do not know that it can be positively refuted. We can have no direct observation of consciousness in any creature but ourselves. But I must say for myself—looking at the matter on the ground of analogy—taking into account that great doctrine of continuity which forbids one to suppose that any natural phenomena can come into existence suddenly and without some precedent, gradual modification tending towards it, and taking into account the incontrovertible fact that the lower vertebrated animals possess, in a less developed condition, that part of the brain which we have every reason to believe is the organ of consciousness in ourselves, it seems vastly more probable that the lower animals, although they may not possess that sort of consciousness which we have ourselves, yet have it in a form proportional to the comparative development of the organ of that consciousness, and foreshadow more or less dimly those feelings which we possess ourselves. I think that is the most rational conclusion that can be come to. It has this advantage, though this is a consideration which could not be urged in dealing with questions that are susceptible of demonstration, but which is well worthy of consideration in a case like the present, that it relieves us of the very terrible consequences of making any mistake on this subject. I must confess that, looking at the terrible struggle for existence which is everywhere going on in the animal world, and considering the frightful quantity of pain with which that process must be accompanied, if animals are sensitive, I should be glad if the probabilities were in favour of the view of Descartes. But, on the other hand, considering that if we were to regard animals as mere machines, we might indulge in unnecessary cruelties and in careless treatment of them, I must confess I think it much better to err on the right side, and not to concur with Descartes on this point.

But let me point out to you that although we may come to the conclusion that Descartes was wrong in supposing that animals are insensible machines, it does not in the slighest degree follow that they are not sensitive and conscious automata; in fact, that is the view which is more or less clearly in the minds of every one of us. When we talk of the lower animals being provided with instinct, and not with reason, what we really mean is, that although they are sensitive and although they are conscious, yet they act mechanically, and that their different states of consciousness, their sensations, their thoughts (if they have any), their volitions (if they have any), are the products and consequences of their mechanical arrangements. I must confess that this popular view is to my mind the only one which can be scientifically adopted. We are bound by everything we know of the operations of the nervous system to believe that when a certain molecular change is brought about in the central part of the nervous system, that change, in some way utterly unknown to us, causes that state of consciousness that we term a sensation. It is not to be doubted that those motions which give rise to sensation leave in the brain changes of its substance which answer to what Haller called "*vestigia rerum*," and to what that great thinker, David Hartley, termed "Vibratiuncules." The sensation which has passed away leaves behind molecules of the brain competent to its reproduction—"sensigenous molecules," so to speak—which constitute the physical foundation of memory. Other molecular changes give rise to conditions of pleasure and pain, and to the emotion which in ourselves we call volition. I have no doubt that is the relation between the physical processes of the animal and his mental processes. In this case it follows inevitably that these states of consciousness can have no sort of relation of causation to the motions of the muscles of the body. The volitions of animals will be simply states of emotion which precede their actions. To make clear what I mean, suppose I had a frog placed in my hand, and that I could make it, by turning my hand, perform this balancing movement. If the frog were a philosopher, he might reason thus :—"I feel myself uncomfortable and slipping, and, feeling myself uncomfortable, I put my legs out to save myself. Knowing that I shall tumble if I do not put them further, I put them further still, and my volition brings about all these beautiful adjustments which result in my sitting safely." But if the frog so reasoned, he would be entirely mistaken; for the frog does the thing just as well when he has no reason, no sensation, no possibility of thought of any kind. The only conclusion, then, at which there seems any good ground for arriving is that animals are machines, but that they are conscious machines.

I might with propriety consider what I have now said as the conclusion of the observations which I have to offer concerning animal automatism. So far as I know, the problem which we have hitherto been discussing is an entirely open one. I do not know that there is any reason why any person, whatever his opinions may be, should be prevented, if he be so inclined, from accepting the doctrine which I have just now put before you. So far as we know, animals are conscious automata. That doctrine is perfectly consistent with any view that we may choose to take on the very curious speculation—Whether animals possess souls or not, and if they possess souls, whether those souls are immortal or not. The doctrine to which I have referred is not inconsistent with the perfectly strict and literal adherence to the Scripture text concerning "the beast that perisheth," nor, on the other hand, does it prevent anyone from entertaining the amiable convictions ascribed by Pope to his untutored savage, that when he passed to the realms of the blessed "his faithful dog should bear him company." In fact, all these accessory questions to which I have referred involve problems which cannot be discussed by physical science, inasmuch as they do not lie within the scope of physical science, but come into the province of that great mother of all science, Philosophy. Before any direct answer can be given upon any of these questions we must hear what Philosophy has to say for or against the views that may be held. I need hardly say—especially having detained you so long as I find I have done—that I do not propose to enter into that region of discussion, and I might, properly enough, finish what I have to say upon the subject—especially as I have reached its natural limits—if it were not that an experience, now, I am sorry to say, extending over a good many years, leads me to anticipate that what I have brought before you to-night is not likely to escape the fate which, upon many occasions within my recollection, has attended statements of scientific doctrine and of the conclusions towards which science is tending, which have been made in a spirit intended at any rate to be as calm and as judicial as that in which I have now laid these facts before you. I do not doubt that the fate which has befallen better men will befall me, and that I shall have to bear in patience the reiterated assertion that doctrines such as I have put before you have very evil tendencies. I should not wonder if you were to be told by persons speaking with authority—not, perhaps, with that authority which is based upon knowledge and wisdom, but still with authority—that my intention in bringing this subject before you is to lead you to apply the doctrine I have stated, to man as well as brutes, and it will then certainly be further asserted that the logical tendency of such a doctrine is Fatalism, Materialism, and Atheism. Now, let me ask you to listen to another product of that long experience to which I referred. Logical consequences are very important; but in the course of my experience I have found that they are the scarecrows of fools and the beacons of wise men. Logical consequences can take care of themselves. The only question for any man to ask is—"Is this doctrine true, or is it false?" No other question can possibly be taken into consideration until that one is settled. And, as I have said, the logical consequences of doctrines can only serve as a warning to wise men to ponder well whether the doctrine submitted for their consideration be true or not, and to test it in every possible direction. Undoubtedly I do hold that the view I have taken of the relations between the physical and mental faculties of brutes applies in its fulness and entirety to man; and if it were true that the logical consequences of that belief must land me in all these terrible consequences, I should not hesitate in allowing myself to be so landed. I should conceive that if I refused I should have done the greatest and most abominable violence to everything which is deepest in my moral nature. But now I beg leave to say that, in my conviction, there is no such logical connection as is pretended between the doctrine I accept and the consequences which people profess to draw from it. Some years ago I had occasion, in dealing with the philosophy of Descartes, and some other matters, to state my conviction pretty fully on those subjects, and, although I know from experience how futile it is to endeavour to escape from those nicknames which many people mistake for argument, yet, if those who care to investigate these questions in a spirit of candour and justice will look into those writings of mine, they will see my reasons for not imagining that such conclusions can be drawn from such premises. To those who do not look into these matters with candour and with a desire to know the truth, I have nothing whatever to say, except to warn them on their own behalf what they do; for assuredly if, for preaching such doctrine as I have preached to you to-night, I am cited before the bar of public opinion, I shall not stand there alone. On my one hand I shall have, among theologians, St. Augustine, John Calvin, and a man whose name should be well known to the Presbyterians of Ulster—Jonathan Edwards—unless, indeed, it be the fashion to neglect the study of the great masters of divinity, as many other great studies are neglected nowadays; and I should have upon my other hand, among philosophers, Leibnitz; I should have Père Malebranche, who saw all things in God; I should have David Hartley, the theologian as well as philosopher; I should have Charles Bonnet, the eminent naturalist, and one of the most zealous defenders Christianity has ever had. I think I should have, within easy reach, at any rate, John Locke. Certainly the school of Descartes would be there, if not their master; and I am inclined to think that, in due justice, a citation would have to be served upon Immanuel Kant himself. In such society it may be better to be a prisoner than a judge; but I would ask those who are likely to be influenced by the din and clamour which are raised about these questions, whether they are more likely to be right in assuming that those great men I have mentioned—the fathers of the Church and the fathers of Philosophy—knew what they were about; or that the pigmies who raise the din know better than they did what they meant. It is not necessary for any man to occupy himself with problems of this kind unless he so choose. Life is full enough, filled to the brim, by the performance of its ordinary duties; but let me warn you, let me beg you to believe, that if a man elect to give a judgment upon these great questions; still more, if he assume to himself the responsibility of attaching praise or blame to his fellow-men for the judgments which they may venture to express—then, unless he would commit a sin more grievous than most of the breaches of the Decalogue, he must avoid a lazy reliance upon the information that is gathered by prejudice and filtered through passion. Let him go to those great sources that are open to him as to every one, and to no man more open than to an Englishman; let him go back to the facts of nature, and to the thoughts of those wise men who for generations past have been the interpreters of nature.

THE CARNIVOROUS HABITS OF PLANTS *

I HAVE chosen for the subject of my address to you from the chair in which the Council of the British Association has done me the honour of placing me, the carnivorous habits of some of our brother-organisms—Plants.

Various observers have described with more or less accuracy the habits of such vegetable sportsmen as the Sundew, the Venus's Fly-trap, and the Pitcher-plants, but few have inquired into their motives; and the views of those who have most accurately appreciated these have not met with that general acceptance which they deserved.

Quite recently the subject has acquired a new interest, from the researches of Mr. Darwin into the phenomena which accompany the placing albuminous substances on the leaves of Drosera and Pinguicula, and which, in the opinion of a very eminent physiologist, prove, in the case of Dionæa, that this plant digests exactly the same substances and in exactly the same way that the human stomach does. With these researches Mr. Darwin is still actively engaged, and it has been with the view of rendering him such aid as my position and opportunities at Kew afforded me, that I have, under his instructions, examined some other carnivorous plants.

In the course of my inquiries I have been led to look into the early history of the whole subject, which I find to be so little known and so interesting that I have thought that a sketch of it, up to the date of Mr. Darwin's investigations, might prove acceptable to the members of this Association. In drawing it up, I have been obliged to limit myself to the most important plants; and with regard to such of these as Mr. Darwin has studied, I leave it to him to announce the discoveries which, with his usual frankness, he has communicated to me and to other friends; whilst with regard to those which I have myself studied, Sarracenia and Nepenthes, I shall briefly detail such of my observations and experiments as seem to be the most suggestive.

Dionæa.—About 1768 Ellis, a well-known English naturalist, sent to Linnæus a drawing of a plant, to which he gave the poetical name of Dionæa. "In the year 1765," he writes, "our late worthy friend, Mr. Peter Collinson, sent me a dried specimen of this curious plant, which he had received from Mr. John Bartram, of Philadelphia, botanist to the late King." Ellis flowered the plant in his chambers, having obtained living specimens from America. I will read the account which he gave of it to Linnæus, and which moved the great naturalist to declare that, though he had seen and examined no small number of plants, he had never met with so wonderful a phenomenon:—

"The plant, Ellis says, shows that Nature may have some views towards its nourishment, in forming the upper joint of its leaf like a machine to catch food; upon the middle of this lies the bait for the unhappy insect that becomes its prey. Many minute red glands that cover its surface, and which perhaps discharge sweet liquor, tempts the animal to taste them; and the instant these tender parts are irritated by its feet, the two lobes rise up, grasp it fast, lock the rows of spines together, and squeeze it to death. And further, lest the strong efforts for life in the creature just taken should serve to disengage it, three small erect spines are fixed near the middle of each lobe, among the glands, that effectually put an end to all its struggles. Nor do the lobes ever open again, while the dead animal continues there. But it is nevertheless certain that the plant cannot distinguish an animal from a vegetable or mineral substance; for if we introduce a straw or pin between the lobes, it will grasp it fully as fast as if it was an insect."

---

* Address in the Department of Zoology and Botany, British Association, Belfast, August 21, by Dr. Hooker, C.B., D.C.L., Pres. R.S.

This account, which in its way is scarcely less horrible than the descriptions of those mediæval statues which opened to embrace and stab their victims, is substantially correct, but erroneous in some particulars. I prefer to trace out our knowledge of the facts in historical order, because it is extremely important to realise in so doing how much our appreciation of tolerably simple matters may be influenced by the prepossessions that occupy our mind.

We have a striking illustration of this in the statement published by Linnæus a few years afterwards. All the facts which I have detailed to you were in his possession; yet he was evidently unable to bring himself to believe that Nature intended the plant—to use Ellis's words—"to receive some nourishment from the animals it seizes;" and he accordingly declared, that as soon as the insects ceased to struggle, the leaf opened and let them go. He only saw in these wonderful actions an extreme case of sensitiveness in the leaves, which caused them to fold up when irritated, just as the sensitive plant does; and he consequently regarded the capture of the disturbing insect as something merely accidental and of no importance to the plant. He was, however, too sagacious to accept Ellis's sensational account of the *coup de grace* which the insects received from the three stiff hairs in the centre of each lobe of the leaf.

Linnæus's authority overbore criticism, if any were offered; and his statements about the behaviour of the leaves were faithfully copied from book to book.

Broussonet (in 1784) attempted to explain the contraction of the leaves by supposing that the captured insect pricked them, and so let out the fluid which previously kept them turgid and expanded.

Dr. Darwin (1761) was contented to suppose that the Dionæa surrounded itself with insect traps to prevent depredations upon its flowers.

Sixty years after Linnæus wrote, however, an able botanist, the Rev. Dr. Curtis (dead but a few years since) resided at Wilmington, in North Carolina, the head-quarters of this very local plant. In 1834 he published an account of it in the *Boston Journal of Natural History*, which is a model of accurate scientific observation. This is what he said:—"Each half of the leaf is a little concave on the inner side, where are placed three delicate hair-like organs, in such an order that an insect can hardly traverse it without interfering with one of them, when the two sides suddenly collapse and enclose the prey, with a force surpassing an insect's efforts to escape. The fringe of hairs on the opposite sides of a leaf interlace, like the fingers of two hands clasped together. The sensitiveness resides only in these hair-like processes on the inside, as the leaf may be touched or pressed in any other part without sensible effects. The little prisoner is not crushed and suddenly destroyed, as is sometimes supposed, for I have often liberated captive flies and spiders, which sped away as fast as fear or joy could carry them. At other times I have found them enveloped in a fluid of a mucilaginous consistence, which seems to act as a solvent, the insects being more or less consumed in it."

To Ellis belongs the credit of divining the purpose of the capture of insects by the Dionæa. But Curtis made out the details of the mechanism, by ascertaining the seat of the sensitiveness in the leaves; and he also pointed out that the secretion was not a lure exuded before the capture, but a true digestive fluid poured out, like our own gastric juice after the ingestion of food.

For another generation the history of this wonderful plant stood still; but in 1868 an American botanist, Mr. Canby, who is happily still engaged in botanical research—while staying in the Dionæa district, studied the habits of the plant pretty carefully, especially the points which Dr. Curtis had made out. His first idea was that "the leaf had the power of dissolving animal matter, which was then allowed to flow along the somewhat trough-like petiole to the root, thus furnishing the plant with highly nitrogenous food." By feeding the leaves with small pieces of beef, he found, however, that these were completely dissolved and absorbed; the leaf opening again with a dry surface, and ready for another meal, though with an appetite somewhat jaded. He found that cheese disagreed horribly with the leaves, turning them black, and finally killing them. Finally, he details the useless struggles of a Curculio to escape, as thoroughly establishing the fact that the fluid already mentioned is actually secreted, and is not the result of the decomposition of the substance which the leaf has seized. The Curculio being of a resolute nature, attempted to eat his way out,—"when discovered he was still alive, and had made a small hole through the side of the leaf, but was evidently becoming very weak. On opening the leaf, the fluid was found in considerable quantity around him, and was without doubt gradually overcoming him. The leaf being again allowed to close upon him, he soon died."

At the meeting of this Association last year, Dr. Burdon-Sanderson made a communication, which, from its remarkable character, was well worthy of the singular history of this plant; one by no means closed yet, but in which his observations will head a most interesting chapter.

It is a generalisation—now almost a household word—that all living things have a common bond of union in a substance—always present where life manifests itself—which underlies all their details of structure. This is called *protoplasm*. One of its most distinctive properties is its aptitude to contract; and when in any given organism the particles of protoplasm are so arranged that they act as it were in concert, they produce a cumulative effect which is very manifest in its results. Such a manifestation is found in the contraction of muscle; and such a manifestation we possibly have also in the contraction of the leaf of Dionæa.

The contraction of muscle is well known to be accompanied by certain electrical phenomena. When we place a fragment of muscle in connection with a delicate galvanometer, we find that between the outside surface and a cut surface there is a definite current, due to what is called the electromotive force of the muscle. Now, when the muscle is made to contract, this electromotive force momentarily disappears. The needle of the galvanometer, deflected before, swings back towards the point of rest; there is what is called a *negative variation*. All students of the vegetable side of organised nature were astonished to hear from Dr. Sanderson that certain experiments which, at the instigation of Mr. Darwin, he had made, proved to demonstration that when a leaf of Dionæa contracts, the effects produced are precisely similar to those which occur when muscle contracts.

Not merely, then, are the phenomena of digestion in this wonderful plant like those of animals, but the phenomena of contractility agree with those of animals also.

Drosera.—Not confined to a single district in the New World, but distributed over the temperate parts of both hemispheres, in sandy and marshy places, are the curious plants called Sundews—the species of the genus Drosera. They are now known to be near congeners of Dionæa, a fact which was little more than guessed at when the curious habits which I am about to describe were first discovered.

Within a year of each other, two persons—one an Englishman, the other a German—observed that the curious hairs which every-one notices on the leaf of Drosera were sensitive.

This is the account which Mr. Gardom, a Derbyshire botanist, gives of what his friend Mr. Whateley, "an eminent London surgeon," made out in 1780:—"On inspecting some of the contracted leaves we observed a small insect or fly very closely imprisoned therein, which occasioned some astonishment as to how it happened to get into so confined a situation. Afterwards, on Mr. Whateley's centrically pressing with a pin other leaves yet in their natural and expanded form, we observed a remarkably sudden and elastic spring of the leaves, so as to become inverted upwards, and, as it were, encircling the pin, which evidently showed the method by which the fly came into its embarrassing situation."

This must have been an account given from memory, and represents the movement of the hairs as much more rapid than it really is.

In July of the preceding year (though the account was not published till two years afterwards), Roth, in Germany, had remarked in *Drosera rotundifolia* and *longifolia*, "that many leaves were folded together from the point towards the base, and that all the hairs were bent like a bow, but that there was no apparent change on the leaf-stalk." Upon opening these leaves, he says, "I found in each a dead insect; hence I imagined that this plant, which has some resemblance to the *Dionæa muscipula*, might also have a similar moving power."

"With a pair of pliers I placed an ant upon the middle of the leaf of *D. rotundifolia*, but not so as to disturb the plant The ant endeavoured to escape, but was held fast by the clammy juice at the points of the hairs, which was drawn out by its feet into fine threads. In some minutes the short hairs on the disc of the leaf began to bend, then the long hairs, and laid themselves upon the insect. After a while the leaf began to bend, and in some hours the end of the leaf was so bent inwards as to touch the base. The ant died in fifteen minutes, which was before all the hairs had bent themselves."

These facts, established nearly a century ago by the testimony of independent observers, have up to the present time been almost ignored; and Trecul, writing in 1855, boldly asserted that the facts were not true.

More recently, however, they have been repeatedly verified: in Germany by Nilschke, in 1860; in America by a lady, Mrs. Treat, of New Jersey, in 1871; in this country by Mr. Darwin, and also by Mr. A. W. Bennett.

To Mr. Darwin, who for some years past has had the subject under investigation, we are indebted, not merely for the complete confirmation of the facts attested by the earliest observers, but also for some additions to those facts which are extremely important. The whole investigation still awaits publication at his hands, but some of the points which were established have been announced by Professor Asa Gray in America, to whom Mr. Darwin had communicated them.

Mr. Darwin found that the hairs on the leaf of Drosera responded to a piece of muscle or other animal substance, while to any particle of inorganic matter they were nearly indifferent. To minute fragments of carbonate of ammonia they were more responsive.

I will now give the results of Mrs. Treat's experiments, in her own words:—

"Fifteen minutes past ten I placed bits of raw beef on some of the most vigorous leaves of *Drosera longifolia*. Ten minutes past twelve two of the leaves had folded around the beef, hiding it from sight. Half-past eleven on the same day, I placed living flies on the leaves of *D. longifolia*. At twelve o'clock and forty-eight minutes, one of the leaves had folded entirely round its victim, and the other leaves had partially folded, and the flies had ceased to struggle. By half-past two, four leaves had each folded around a fly. The leaf folds from the apex to the petiole, after the manner of its vernation. I tried mineral substances, bits of dried chalk, magnesia, and pebbles. In twenty-four hours neither the leaves nor the bristles had made any move in clasping these articles. I wetted a piece of chalk in water, and in less than an hour the bristles were curving about it, but soon unfolded again, leaving the chalk free on the blade of the leaf."

Time will not allow me to enter into further details with respect to Dionæa and Drosera. The repeated testimony of various observers spreads over a century, and though at no time warmly received, must, I think, satisfy you that in this small family of the Droseraceæ we have plants which in the first place capture animals for purposes of food, and in the second, digest and dissolve them by means of a fluid which is poured out for the purpose; and thirdly, absorb the solution of animal matter which is so produced.

Before the investigations of Mr. Darwin had led other persons to work at the subject, the meaning of these phenomena was very little appreciated. Only a few years ago, Duchartre, a French physiological botanist, after mentioning the views of Ellis and Curtis with respect to Dionæa, expressed his opinion that the idea that its leaves absorbed dissolved animal substances was too evidently in disagreement with our knowledge of the function of leaves and the whole course of vegetable nutrition to deserve being seriously discussed.

Perhaps if the Droseraceæ were an isolated case of a group of plants exhibiting propensities of this kind, there might be some reason for such a criticism. But I think I shall be able to show you that this is by no means the case. We have now reason to believe that there are many instances of these carnivorous habits in different parts of the vegetable kingdom, and among plants which have nothing else in common but this.

As another illustration I shall take the very curious group of Pitcher-plants which is peculiar to the New World. And here also I think we shall find it most convenient to follow the historical order in the facts.

Sarracenia.—The genus Sarracenia consists of eight species, all similar in habit, and all natives of the Eastern States of North America, where they are found more especially in bogs, and even in places covered with shallow water. Their leaves, which give them a character entirely their own, are pitcher-shaped or trumpet-like, and are collected in tufts springing immediately from the ground; and they send up at the flowering season one or more slender stems bearing each a solitary flower. This has a singular aspect, due to a great extent to the umbrella like expansion in which the style terminates; the shape of this, or perhaps of the whole flower, caused the first English settlers to give to the plant the name of Side-saddle Flower.

Sarracenia purpurea is the best known species. About ten years ago it enjoyed an evanescent notoriety from the fact that its rootstock was proposed as a remedy for small-pox. It is found from Newfoundland southward to Florida, and is fairly hardy under open-air cultivation in the British Isles. At the commencement of the seventeenth century, Clusius published a figure of it, from a sketch which found its way to Lisbon and thence to Paris. Thirty years later Johnson copied this in his edition of Gerard's Herbal, hoping "that some or other that travel into foreign parts may find this elegant plant, *and know* it by this small expression, and bring it home with them, so that we may come to a perfecter knowledge thereof." A few years afterwards this wish was gratified. John Tradescant the younger found the plant in Virginia, and succeeded in bringing it home alive to England. It was also sent to Paris from Quebec by Dr. Sarrazin, whose memory has been commemorated in the name of the genus, by Tournefort.

The first fact which was observed about the pitchers was, that when they grew they contained water. But the next fact which was recorded about them was curiously mythical. Perhaps Morrison, who is responsible for it, had no favourable opportunites of studying them, for he declares them to be, what is by no means really the case, intolerant of cultivation (*respuere culturam videntur*).

He speaks of the lid, which in all the species is tolerably rigidly fixed, as being furnished, by a special act of providence, with a hinge. This idea was adopted by Linnæus, and somewhat amplified by succeeding writers, who declared that in dry weather the lid closed over the mouth, and checked the loss of water by evaporation. Catesby, in his fine work on the Natural History of Carolina, supposed that these water-receptacles might "serve as an asylum or secure retreat for numerous insects, from frogs and other animals which feed on them;"—and others followed Linnæus in regarding the pitchers as reservoirs for birds and other animals, more especially in times of drought; "*præbet aquam sitientibus aviculis.*"

The superficial teleology of the last century was easily satisfied without looking far for explanations, but it is just worth while pausing for a moment to observe that, although Linnæus had no materials for making any real investigation as to the purpose of the pitchers of Sarracenias, he very sagaciously anticipated the modern views as to their affinities. They are now regarded as very near allies of water-lilies—precisely the position which Linnæus assigned to them in his fragmentary attempt at a true natural classification. And besides this, he also suggested the analogy, which, improbable as it may seem at first sight, has been worked out in detail by Baillon (in apparent ignorance of Linnæus' writings) between the leaves of Sarracenia and water-lilies.

Linnæus seems to have supposed that Sarracenia was originally aquatic in its habits, that it had Nymphæa-like leaves, and that when it took to a terrestrial life its leaves became hollowed out, to contain the water in which they could no longer float—in fact, he showed himself to be an evolutionist of the true Darwinian type.

Catesby's suggestion was a very infelicitous one. The insects which visit these plants may find in them a retreat, but it is one from which they never return. Linnæus' correspondent Collinson remarked in one of his letters, that "many poor insects lose their lives by being drowned in these cisterns of water;" but William Bartram, the son of the botanist, seems to have been the first to put on record, at the end of the last century, the fact that Sarracenias catch insects and put them to death in the wholesale way that they do.

Before stopping to consider how this is actually achieved, I will carry the history a little further.

In the two species in which the mouth is unprotected by the lid it could not be doubted that a part, at any rate, of the contained fluid was supplied by rain. But in *Sarracenia variolaris*, in which the lid closes over the mouth, so that rain cannot readily enter it, there is no doubt that a fluid is secreted at the bottom of the pitchers, which probably has a digestive function. William Bartram, in the preface to his travels in 1791, described this fluid, but he was mistaken in supposing that it acted as a lure. There is a sugary secretion which attracts insects, but this is only found at the upper part of the tube. Bartram must be credited with the suggestion, which he, however, only put forward doubtfully, that the insects were dissolved in the fluid, and then became available for the alimentation of the plants.

Sir J. E. Smith, who published a figure and description of *Sarracenia variolaris*, noticed that it secreted fluid, but was content to suppose that it was merely the gaseous products of the decomposition of insects that subserved the processes of vegetation. In 1829, however, thirty years after Bartram's book, Burnett wrote a paper containing a good many original ideas expressed in a somewhat quaint fashion, in which he very strongly insisted on the existence of a true digestive process in the case of Sarracenia, analogous to that which takes place in the stomach of an animal.

Our knowledge of the habits of *Sarracenia variolaris* is now pretty complete, owing to the observations of two South Carolina physicians. One, Dr. M'Bride, made his observations half a century ago, but they had, till quite recently, completely fallen into oblivion. He devoted himself to the task of ascertaining why it was that *Sarracenia variolaris* was visited by flies, and how it was that it captured them. This is what he ascertained :—

"The cause which attracts flies is evidently a viscid substance resembling honey, secreted by or exuding from the internal surface of the tube. From the margin, where it commences, it does not extend lower than one-fourth of an inch. The falling of the insect as soon as it enters the tube is wholly attributable to the downward or inverted position of the hairs of the internal surface of the leaf. At the bottom of a tube split open, the hairs are plainly discernible, pointing downwards; as the eye ranges upward they gradually become shorter and attenuated, till at or just below the surface covered by the bait they are no longer perceptible to the naked eye, nor to the most delicate touch. It is here that the fly cannot take a hold sufficiently strong to support itself, but falls."

Dr. Mellichamp, who is now resident in the district in which Dr. M'Bride made his observations, has added a good many particulars to our knowledge. He first investigated the fluid which is secreted at the bottom of the tubes. He satisfied himself that it was really secreted, and describes it as mucilaginous, but leaving in the mouth a peculiar astringency. He compared the action of this fluid with that of distilled water on pieces of fresh venison, and found that after fifteen hours the fluid had produced most change, and also most smell; he therefore concluded that as the leaves when stuffed with insects become most disgusting in odour, we have to do, not with a true digestion, but with an accelerated decomposition. Although he did not attribute any true digestive power to the fluid secreted by the pitchers, he found that it had a remarkable anæsthetic effect upon flies immersed in it. He remarked that "a fly when thrown into water is very apt to escape, as the fluid seems to *run* from its wings," but it never escaped from the Sarracenia secretion. About half a minute after being thrown in, the fly became to all appearance dead, though, if removed, it gradually recovered in from half an hour to an hour.

According to Dr. Mellichamp, the sugary lure discovered by Dr. M'Bride, at the mouth of the pitchers, is not found on either the young ones of one season or the older ones of the previous year. He found, however, that about May it could be detected without difficulty, and more wonderful still, that there is a honey-baited pathway leading directly from the ground to the mouth, along the broad wing of the pitcher, up which insects are led to their destruction. From these narratives it is evident that there are two very different types of pitcher in Sarracenia, and an examination of the species shows that there may probably be three. These may be primarily classified into those with the mouth open and lid erect, and which consequently receive the rain-water in more or less abundance; and those with the mouth closed by the lid, into which rain can hardly, if at all, find ingress.

To the first of these belongs the well-known *S. purpurea*, with inclined pitchers, and a lid so disposed as to direct all the rain that falls upon it also into the pitcher; also *S. flava, rubra*, and *Drummondi*, all with erect pitchers and vertical lids; of these three, the lid in a young state arches over the mouth, and in an old state stands nearly erect, and has the sides so reflected that the rain which falls on its upper surface is guided down the outside of the back of the pitcher, as if to prevent the flooding of the latter.

To the second group belong *S. psittacina* and *S. variolaris*.

The tissues of the internal surfaces of the pitchers are singularly beautiful. They have been described in one species only, the *S. purpurea*, by August Vogl; but from this all the other species which I have examined differ materially. Beginning from the upper part of the pitcher, there are four surfaces, characterised by different tissues, which I shall name and define as follows :—

1. An *attractive* surface, occupying the inner surface of the lid, which is covered with an epidermis, stomata, and (in common with the mouth of the pitcher) with minute honey-secreting glands; it is further often more highly coloured than any other part of the pitcher, in order to attract insects to the honey.

2. A *conducting* surface, which is opaque, formed of glassy cells, which are produced into deflexed, short, conical, spinous processes. These processes, overlapping like the tiles of a house, form a surface down which an insect slips, and affords no foothold to an insect attempting to crawl up again.

3. A *glandular* surface (seen in *S. purpurea*), which occupies a considerable portion of the cavity of the pitcher below the conducting surface. It is formed of a layer of epidermis with sinuous cells, and is studded with glands; and being smooth and polished, this too affords no foothold for escaping insects.

4. A *detentive* surface, which occupies the lower part of the pitcher, in some cases for nearly its whole length. It possesses no cuticle, and is studded with deflexed, rigid, glass-like, needle-formed, striated hairs, which further converge towards the axis of the diminishing cavity; so that an insect, if once amongst them, is effectually detained, and its struggles have no other result than to wedge it lower and more firmly in the pitcher.

Now, it is a very curious thing that in *S. purpurea*, which has an open pitcher, so formed as to receive and retain a maximum of rain, no honey-secretion has hitherto been found, nor has any water been seen to be secreted in the pitcher; it is, further, the only species in which (as stated above) I have found a special glandular surface, and in which no glands occur on the detentive surface. This concurrence of circumstances suggests the possibility of this plant either having no proper secretion of its own, or only giving it off after the pitcher has been filled with rain-water.

In *S. flava*, which has open-mouthed pitchers and no special glandular surface, I find glands in the upper portion of the detentive surface, among the hairs, but not in the middle or lower part of the same surface. It is proved that *S. flava* secretes fluid, but under what precise conditions I am not aware. I have found none but what may have been accidentally introduced in the few cultivated specimens which I have examined, either in the full-grown state, or in the half-grown when the lid arches over the pitcher. I find the honey in these as described by the American observers, and honey-secreting glands on the edge of the wing of the pitcher, together with similar glands on the outer surface of the pitcher, as seen by Vogl in *S. purpurea*.

Of the pitchers with closed mouths, I have examined those of *S. variolaris* only, whose tissues closely resemble those of *S. flava*. That it secretes a fluid noxious to insects there is no doubt, though in the specimens I examined I found none.

There is thus obviously much still to be learned with regard to Sarracenia, and I hope that American botanists will apply themselves to this task. It is not probable that three pitchers, so differently constructed as those of *S. flava, purpurea*, and *variolaris*, and presenting such differences in their tissues, should act similarly. The fact that insects normally decompose in the fluid of all, would suggest the probability that they all feed on the products of decomposition; but as yet we are absolutely ignorant whether the glands within the pitchers are secretive, or absorptive, or both; if secretive, whether they secrete water or a solvent; and if absorptive, whether they absorb animal matter or the products of decomposition.

It is quite likely, that just as the saccharine exudation only makes its appearance during one particular period in the life of the pitcher, so the digestive functions may also be only of short duration. We should be prepared for this from the case of the Dionæa, the leaves of which cease after a time to be fit for absorption, and become less sensitive. It is quite certain that the insects which go on accumulating in the pitchers of Sarracenias must be far in excess of its needs for any legitimate process of digestion. They decompose; and various insects, too wary to be entrapped themselves, seem habitually to drop their eggs into the open mouth of the pitchers, to take advantage of the accumulation of food. The old pitchers are consequently found to contain living larvæ and maggots, a sufficient proof that the original properties of the fluid which they secreted must have become exhausted; and Barton tells us that various insectivorous birds slit open the pitchers with their beaks to get at the contents. This was probably the origin of Linnæus' statement that the pitchers supplied birds with water.

The pitchers finally decay, and part, at any rate, of their contents must supply some nutriment to the plant by fertilising the ground in which it grows.

Darlingtonia.—I cannot take leave of Sarracenia without a short notice of its near ally, Darlingtonia, a still more wonderful plant, an outlier of Sarracenia in geographical distribution, being found at an elevation of 5,000 ft. on the Sierra Nevada of California, far west of any locality inhabited by Sarracenia. It has pitchers of two forms; one, peculiar to the infant state of the plant, consists of narrow, somewhat twisted, trumpet-shaped tubes, with very oblique open mouths, the dorsal lip of which is drawn out into a long, slender, arching, scarlet hood, that hardly closes the mouth. The slight twist in the tube causes these mouths to point in various directions, and they entrap very small insects only. Before arriving at a state of maturity the plant bears much larger, suberect pitchers, also twisted, with the lip produced into a large inflated hood, that completely arches over a very small entrance to the cavity of the pitcher. A singular orange-red, flabby, two-lobed organ hangs from the end of the hood, right in front of the entrance, which, as I was informed last week by letter from Prof. Asa Gray, is smeared with honey on its inner surface. These pitchers are crammed with large insects, especially moths, which decompose in them, and result in a putrid mass. I have no information of water being found in its pitchers in its native country, but have myself found a slight acid secretion in the young states of both forms of pitcher.

The tissues of the inner surfaces of the pitchers of both the young and the old plant I find to be very similar to those of *Sarracenia variolaris* and *flava*.

Looking at a flowering specimen of Darlingtonia, I was struck with a remarkable analogy between the arrangement and colouring of the parts of the leaf and of the flower. The petals are of the same colour as the flap of the pitcher, and between each pair of petals is a hole (formed by a notch in the opposed margins of each) leading to the stamens and stigma. Turning to the pitcher, the relation of its flap to its entrance is somewhat similar. Now, we know that coloured petals are specially attractive organs, and that the object of their colour is to bring insects to feed on the pollen or nectar, and in this case by means of the hole to fertilise the flower; and that the object of the flap and its sugar is also to attract insects, but with a very different result, cannot be doubted. It is hence conceivable that this marvellous plant lures insects to its flowers for one object, and feeds them while it uses them to fertilise itself, and that, this accomplished, some of its benefactors are thereafter lured to its pitchers for the sake of feeding itself!

But to return from mere conjecture to scientific earnest, I cannot dismiss Darlingtonia without pointing out to you what appears to me a most curious point in its history; which is, that the change from the slender, tubular, open mouthed to the inflated closed-mouthed pitchers is, in all the specimens which I have examined, absolutely sudden in the individual plant. I find no pitchers in an intermediate stage of development. This, a matter of no little significance in itself, derives additional interest from the fact that the young pitchers to a certain degree represent those of the Sarracenias with open mouths and erect lids; and the old pitchers those of the Sarracenias with closed mouths and globose lids. The combination of representative characters in an outlying species of a small order cannot but be regarded as a marvellously significant fact in the view of those morphologists who hold the doctrine of evolution.

Nepenthes.—The genus Nepenthes consists of upwards of thirty species of climbing, half shrubby plants, natives of the hotter parts of the Asiatic Archipelago from Borneo to Ceylon, with a few outlying species in New Caledonia, in Tropical Australia, and in the Seychelle Islands on the African coast. Its pitchers are abundantly produced, especially during the younger state of the plants. They present very considerable modifications of form and external structure, and vary greatly in size, from little more than an inch to almost a foot in length; one species, indeed, which I have here from the mountains of Borneo, has pitchers which, including the lid, measure a foot and a half, and its capacious bowl is large enough to drown a small animal or bird.

The structure of the pitcher of Nepenthes is less complicated on the whole than that of Sarracenia, though some of its tissues are much more highly specialised. The pitcher itself is here not a transformed leaf, as in Sarracenia, nor is it a transformed leaf-blade, like that of Dionæa, but an appendage of the leaf developed at its tip, and answers to a water-secreting gland that may be seen terminating the mid-rib of the leaf of certain plants. It is furnished with a stalk, often a very long one, which in the case of pitchers formed on leaves high up the stem has (before the full development of the pitcher) the power of twisting like a tendril round neighbouring objects, and thus aiding the plant in climbing, often to a great height in the forest.

In most species the pitchers are of two forms, one appertaining to the young, the other to the old state of the plant, the transition from one form to the other being gradual. Those of the young state are shorter and more inflated; they have broad fringed longitudinal wings on the outside, which are probably guides to lead insects to the mouth; the lid is smaller and more open, and the whole interior surface is covered with secreting glands. Being formed near the root of the plant, these pitchers often rest on the ground, and in species which do not form leaves near the root they are sometimes suspended from stalks which may be fully a yard long, and which bring them to the ground. In the older state of the plant the pitchers are usually much longer, narrower, and less inflated, and are trumpet-shaped, or even conical; the wings also are narrower, less fringed, or almost absent. The lid is larger and slants over the mouth, and only the lower part of the pitcher is covered with secreting glands, the upper part presenting a tissue analogous to the conducting tissue of Sarracenia, but very different anatomically. The difference in structure of these two forms of pitcher, if considered in reference to their different positions on the plant, forces the conclusion on the mind that the one form is intended for ground game, the other for winged game. In all cases the mouth of the pitcher is furnished with a thickened corrugated rim, which serves three purposes: it strengthens the mouth and keeps it distended; it secretes honey (at least in all the species I have examined under cultivation, for I do not find that any other observer has noticed the secretion of honey by Nepenthes), and it is in various species developed into a funnel-shaped tube that descends into the pitcher and prevents the escape of insects, or into a row of incurved hooks that are in some cases strong enough to retain a small bird, should it, when in search of water or insects, thrust its body beyond a certain length into the pitcher.

In the interior of the pitcher of Nepenthes there are three principal surfaces: an *attractive*, *conductive*, and a *secretive* surface; the *detentive* surface of Sarracenia being represented by the fluid secretion, which is here invariably present at all stages of growth of the pitcher.

The attractive surfaces of Nepenthes are two: those, namely, of the rim of the pitcher, and of the under surface of the lid, which is provided in almost every species with honey-secreting glands, often in great abundance. These glands consist of spherical masses of cells, each embedded in a cavity of the tissue of the lid, and encircled by a guard-ring of glass-like cellular tissue. As in Sarracenia, the lid and mouth of the pitcher are more highly coloured than any other part, with the view of attracting insects to their honey. It is a singular fact that the only species known to me that wants these honey-glands on the lid is the *N. ampullaria*, whose lid, unlike that of the other species, is thrown back horizontally. The secretion of honey on a lid so placed would tend to lure insects away from the pitcher instead of into it.

From the mouth to a variable distance down the pitcher is an opaque glaucous surface, precisely resembling in colour and appearance the conductive surface of the Sarracenia, and, like it, affording no foothold to insects, but otherwise wholly different; it is formed of a fine network of cells, covered with a glass-like cuticle, and studded with minute reniform transverse excrescences.

The rest of the pitcher is entirely occupied with the secretive surface, which consists of a cellular floor crowded with spherical glands in inconceivable numbers. Each gland precisely resembles a honey-gland of the lid, and is contained in a pocket of the same nature, but semicircular, with the mouth downwards, so that the secretive fluid all falls to the bottom of the pitcher. In the *Nepenthes Rafflesiana* 3,000 of the glands occur on a square inch of the inner surface of the pitcher, and upwards of 1,000,000 in an ordinary sized pitcher. I have ascertained that, as was indeed to be expected, they secrete the fluid which is contained in the bottom of the pitcher before this opens, and that the fluid is always acid.

The fluid, though invariably present, occupies a comparatively small portion of the glandular surface of the pitcher, and is collected before the lid opens. When the fluid is emptied out of a fully formed pitcher that has not received animal matter, it forms again, but in comparatively very small quantities; and the formation goes on for many days, and to some extent even after the pitcher has been removed from the plant. I do not find that placing inorganic substances in the fluid causes an increased secretion, but I have twice observed a considerable increase of fluid in pitchers after putting animal matter in the fluid.

To test the digestive powers of Nepenthes I have closely followed Mr. Darwin's treatment of Dionæa and Drosera, employing white of egg, raw meat, fibrine, and cartilage. In all cases the action is most evident, in some surprising. After twenty-four hours' immersion the edges of the cubes of white of egg are eaten away and the surfaces gelatinised. Fragments of meat are rapidly reduced; and pieces of fibrine weighing several grains dissolve and totally disappear in two or three days. With cartilage the action is most remarkable of all; lumps of this weighing 8 or 10 grains are half gelatinised in twenty-four hours, and in three days the whole mass is greatly diminished, and reduced to a clear transparent jelly. After drying some cartilage in the open air for a week, and placing it in an unopened but fully formed pitcher of *N. Rafflesiana*, it was acted upon similarly and very little slower.

That this process, which is comparable to digestion, is not wholly due to the fluid first secreted by the glands, appears to me most probable; for I find that very little action takes place in any of the substances placed in the fluid drawn from pitchers, and put in glass tubes; nor has any followed after six days' immersion of cartilage or fibrine in pitchers of *N. ampullaria* placed in a cold room; whilst on transferring the cartilage from the pitcher of *N. ampullaria* in the cold room to one of *Rafflesiana* in the stove, it was immediately acted upon. Comparing the action of fibrine, meat, and cartilage placed in tubes of Nepenthes fluid, with others in tubes of distilled water, I observed that their disintegration is three times more rapid in the fluid; but this disintegration is wholly different from that effected by immersion in the fluid of the pitcher of a living plant.

In the case of small portions of meat, ¼ to 2 grains, all seem to be absorbed; but with 8 to 10 grains of cartilage it is not so—a certain portion disappears, the rest remains as a transparent jelly, and finally becomes putrid, but not till after many days. Insects appear to be acted upon somewhat differently, for after several days' immersion of a large piece of cartilage I found that a good-sized cockroach, which had followed the cartilage and was drowned for his temerity, in two days became putrid. In removing the cockroach the cartilage remained inodorous for many days. In this case no doubt the antiseptic fluid had permeated the tissue of the cartilage, whilst enough did not remain to penetrate the chitinous hard covering of the insect, which consequently decomposed.

In the case of cartilage placed in fluid taken from the pitcher—it becomes putrid, but not so soon as if placed in distilled water.

From the above observations it would appear probable that a substance acting as pepsine is given off from the inner wall of the pitcher, but chiefly after placing animal matter in the acid fluid; but whether this active agent flows from the glands or from the cellular tissue in which they are imbedded, I have no evidence to show.

I have here not alluded to the action of these animal matters in the cells of the glands, which is, as has been observed by Mr. Darwin in Drosera, to bring about remarkable changes in their protoplasm, ending in their discoloration. Not only is there aggregation of the protoplasm in the gland-cells, but the walls of the cells themselves become discoloured, and the glandular surface of the pitcher that at first was of a uniform green, becomes covered with innumerable brown specks (which are the discoloured glands). After the function of the glands is exhausted, the fluid evaporates, and the pitcher slowly withers.

At this stage I am obliged to leave this interesting investigation. That Nepenthes possesses a true digestive process such as has been proved in the case of Drosera, Dionæa, and Pinguicula, cannot be doubted. This process, however, takes place in a fluid which deprives us of the power of following it further by direct observation. We cannot here witness the pouring out of the digestive fluid; we must assume its presence and nature from the behaviour of the animal matter placed in the fluid in the pitcher. From certain characters of the cellular tissues of the interior walls of the pitcher, I am disposed to think that it takes little part in the processes of either digestion or assimilation, and that these, as well as the pouring out of the acid fluid, are all functions of the glands.

In what I have said I have described the most striking instances of plants which seem to invert the order of nature, and to draw their nutriment—in part, at least—from the animal kingdom, which it is often held to be the function of the vegetable kingdom to sustain.

I might have added some additional cases to those I have already dwelt upon. Probably, too, there are others still unknown to science, or whose habits have not yet been detected. Delpino, for example, has suggested that a plant, first described by myself in the Botany of the Antarctic Voyage, *Caltha dionææfolia*, is so analogous in the structure of its leaves to Dionæa, that it is difficult to resist the conviction that its structure also is adapted for the capture of small insects.

But the problem that forces itself upon our attention is, How does it come to pass that these singular aberrations from the otherwise uniform order of vegetable nutrition make their appearance in remote parts of the vegetable kingdom? why are they not more frequent, and how were such extraordinary habits brought about or contracted? At first sight the perplexity is not diminished by considering—as we may do for a moment—the nature of ordinary vegetable nutrition. Vegetation, as we see it everywhere, is distinguished by its green colour, which we know depends on a peculiar substance called chlorophyll, a substance which has the singular property of attracting to itself the carbonic acid gas which is present in minute quantities in the atmosphere, of partly decomposing it, so far as to set free a portion of its oxygen, and of recombining it with the elements of water, to form those substances, such as starch, cellulose, and sugar, out of which the framework of the plant is constructed.

But, besides these processes, the roots take up certain matters from the soil. Nitrogen forms nearly four-fifths of the air we breathe, yet plants can possess themselves of none of it in the free uncombined state. They withdraw nitrates and salts of ammonia in minute quantities from the ground, and from these they build up with starch, or some analogous material, albuminoids or protein compounds, necessary for the sustentation and growth of protoplasm.

At first sight nothing can be more unlike this than a Dionæa or a Nepenthes capturing insects, pouring out a digestive fluid upon them, and absorbing the albuminoids of the animal, in a form probably directly capable of appropriation for their own nutrition. Yet there is something not altogether wanting in analogy in the case of the most regularly constituted plants. The seed of the castor-oil plant contains, besides the embryo seedling, a mass of cellular tissue or endosperm filled with highly nutritive substances. The seedling lies between masses of this, and is in contact with it; and as the warmth and moisture of germination set up changes which bring about the liquefaction of the contents of the endosperm and the embryo absorbs them, it grows in so doing, and at last, having taken up all it can from the exhausted endosperm, develops chlorophyll in its cotyledons under the influence of light, and relies on its own resources.

A large number of plants, then, in their young condition, borrow their nutritive compounds ready prepared; and this is in effect what carnivorous plants do later in life.

That this is not a merely fanciful way of regarding the relation of the embryo to the endosperm, is proved by the ingenious experiments of Van Tieghem, who has succeeded in substituting for the real, an artificial endosperm, consisting of appropriate nutritive matters. Except that the embryo has its food given to it in a manner which needs no digestion—a proper concession to its infantine state—the analogy here with the mature plants which feed on organic food seems to be complete.

But we are beginning also to recognise the fact that there are a large number of flowering plants that pass through their lives without ever doing a stroke of the work that green plants do. These have been called Saprophytes. Monotropa, the curious bird's nest orchis (*Neottia nidus-avis*), Epipogium, and Corallorhiza are instances of British plants which nourish themselves by absorbing the partially decomposed materials of other plants, in the shady or marshy places which they inhabit. They reconstitute these products of organic decomposition, and build them up once more into an organism. It is curious to notice, however, that the tissues of Neottia still contain chlorophyll in a nascent though useless state, and that if a plant of it be immersed in boiling water, the characteristic green colour reveals itself.

Epipogium and Corallorhiza have lost their proper absorbent organs; they are destitute of roots, and take in their food by the surfaces of their underground stem structures.

The absolute difference between plants which absorb and nourish themselves by the products of the decomposition of plant-structures, and those which make a similar use of animal structures, is not very great. We may imagine that plants accidentally permitted the accumulation of insects in some parts of their structure, and the practice became developed because it was found to be useful. It was long ago suggested that the receptacle formed by the connate leaves of Dipsacus might be an incipient organ of this kind; and though no insectivorous habit has ever been brought home to that plant, the theory is not improbable.

Linnæus, and more lately Baillon, have shown how a pitcher of Sarracenia may be regarded as a modification of a leaf of the Nymphæa type. We may imagine such a leaf first becoming hollow, and allowing *débris* of different kinds to accumulate; these would decompose, and a solution would be produced, some of the constituents of which would diffuse themselves into the subjacent plant tissues. This is in point of fact absorption, and we may suppose that in the first instance—as perhaps still in *Sarracenia purpurea*—the matter absorbed was merely the saline nutritive products of decomposition, such as ammoniacal salts. The act of digestion—that process by which soluble food is reduced without decomposition to a soluble form fitted for absorption—was doubtless subsequently acquired.

The secretion, however, of fluids by plants is not an unusual phenomenon. In many Aroids a small gland at the apex of the leaves secretes fluid, often in considerable quantities, and the pitcher of Nepenthes is, as I have shown elsewhere, only a gland of this kind, enormously developed. May not, therefore, the wonderful pitchers and carnivorous habit of Nepenthes have both originated by natural selection out of one such honey-secreting gland as we still find developed near that part of the pitcher which represents the tip of the leaf? We may suppose insects to have been entangled in the viscid secretion of such a gland, and to have perished there, being acted upon by those acid secretions that abound in these and most other plants. The subsequent differentiation of the secreting organs of the pitcher into aqueous, saccharine, and acid, would follow *pari passu* with the evolution of the pitcher itself, according to those mysterious laws which result in the correlation of organs and functions throughout the kingdom of Nature; and which, in my apprehension, transcend in wonder and interest those of evolution and the origin of species.

Delpino has recorded the fact that the spathe of Alocasia secretes an acid fluid which destroys the slugs that visit it, and which he believes subserves its fertilisation. Here any process of nutrition can only be purely secondary. But the fluids of plants are in the great majority of cases acid, and, when exuded, would be almost certain to bring about some solution in substances with which they came in contact. Thus the acid secretions of roots were found by Sachs to corrode polished marble surfaces with which they came in contact, and thus to favour the absorption of mineral matter.

The solution of albuminoid substances requires, however, besides a suitable acid, the presence of some other albuminoid substance analogous to pepsine. Such substances, however, are frequent in plants. Besides the well-known diastase, which converts the starch of malt into sugar, there are other instances in the synaptase which determines the formation of hydrocyanic acid from emulsine, and the myrosin which similarly induces the formation of oil of mustard. We need not wonder, then, if the fluid secreted by a plant should prove to possess the ingredients necessary for the digestion of insoluble animal matters.

These remarks will, I hope, lead you to see, that though the processes of plant nutrition are in general extremely different from those of animal nutrition, and involve very simple compounds, yet that the protoplasm of plants is not absolutely prohibited from availing itself of food, such as that by which the protoplasm of animals is nourished; under which point of view these phenomena of carnivorous plants will find their place, as one more link in the continuity of nature.

BRITISH ASSOCIATION REPORTS

Report of the Committee on Mathematical Tables.

The objects for which the Committee were appointed at Edinburgh were twofold, viz., the preparation of a list of tables scattered about in books and mathematical journals and transactions, and the calculation of new tables. With regard to the first object, the tables were roughly divided into three classes, viz. (1) ordinary tables (such as trigonometrical and logarithmic) usually published in books; (2) tables of continuously varying quantities, generally definite integrals; and (3) theory of number of tables. On the first class Mr. J. W. L. Glaisher had already written a report, to which it was intended, after the lapse of several years, to add a supplement; with the second some progress had been made; while Prof. Cayley proposed to undertake the third. The Committee had to acknowledge the assistance of several foreigners, and chiefly of Prof. Bierens de Haan, who had forwarded to them an account of 128 logarithmic and 105 non-logarithmic tables; to Dr. Carl Ohrtmann, of Berlin; and Profs. W. W. Johnson and J. M. Rice, of Annapolis, Maryland. The principal achievement, however, which the Committee had to report related to the second object, and was the completion of the tables of the Elliptic Functions, the commencement of which was noticed in NATURE nearly two years ago, and on which six or seven computers, under the superintendence of Mr. J. Glaisher, F.R.S., and Mr. J. W. L. Glaisher, have since been constantly engaged. These tables (which are of double entry) give the four theta functions, which form the numerators and denominators of the three elliptic functions, and their logarithms for 8,100 arguments; so that they contain nearly 65,000 tabular results. The calculation has been carried to ten figures, but only eight will be printed, the tabular portion of the work occupying 360 pages. Parts of the introduction will be written by Prof. Cayley, Sir William Thomson, and Prof. H. J. S. Smith, and it is hoped that before the next meeting of the Association the whole work, which will form one of the largest tables that have appeared as the result of an original calculation, will be in print. It is perhaps desirable to state that the elliptic functions which have thus been tabulated are, as it were, generalised sines and cosines. Sines and cosines may be combined so as to represent any singly periodic function, as is well known; and in the same way elliptic functions represent every possible doubly periodic function; and no quantities can be of a higher degree of periodicity. The elliptic functions (which are in a sense inverse to Legendre's Elliptic Integrals) are thus quantities of the highest importance and generality in mathematics, and they are daily becoming of more importance in physics. They appear conspicuously in the investigation of the motion of a rigid body and in electrostatics, and have also numerous applications in the theory of numbers. The calculations were just completed before the meeting, and the printing will commence immediately: it is intended that the tables shall be stereotyped to ensure freedom from typographical errors.

Report of the Committee on the Nomenclature of Dynamical and Electrical Units.

They have circulated numerous copies of their last year's report among scientific men both at home and abroad. They believe, however, that in order to render their recommendations fully available for science teaching and scientific work, a full and popular exposition of the whole subject of physical units is necessary, together with a collection of examples (tabular and otherwise) illustrating the application of systematic units to a variety of physical measurements. Students usually find peculiar difficulty in questions relating to units; and even the experienced scientific calculator is glad to have before him concrete examples with which to compare his own results as a security against misapprehension or mistake.

Some members of the Committee have been preparing a small volume of Illustrations of the C. G. S. System (centimetre-gramme-second system) intended to meet this want. The Committee do not desire to be re-appointed; at all events at present.

On Siemens' Pyrometer, by Prof. G. C. Foster.

The committee appointed to report upon Siemens' pyrometer has sought to determine whether or no the resistance is altered after exposure to high temperatures. The resistance was measured by means of Wheatstone's Bridge. An arrangement was adopted whereby the heat of the connecting wires was prevented from affecting the measurements. As a long thick iron tube surrounded the platinum coil of the pyrometer, it was impossible, in order to secure a standard temperature, to plunge the instrument into ice-cold water, because, owing to the conductivity of the iron, there was no certainty that the pyrometer wire was actually at the same temperature as the water. The temperature of 10°, which was near the usual atmospheric temperature, was adopted as the standard.

Four instruments were examined: in one of them (1) the coil was surrounded by an iron sheath, in (2) and (3) a piece of stout platinum foil surrounded the cylinder between the iron sheath and the coil. In (4) there was no iron sheath, but a platinum tube instead. Nos. (1) (2) and (3) were found to be considerably altered after having been exposed to a high temperature. The instruments were placed in an ordinary fire and repeatedly heated to a red heat, at which they were maintained for several hours. The original resistance was ten units. The following numbers show the increase of resistance:—

(1) 0·834 (2) 1·608 (3) 1·169

These numbers expressed as fractions of the original resistance become (1) ·0834 (2) ·1608 (3) ·1169.

Equivalent change of temperature = (1) 30°, (2) 58°, (3) 43°. These measurements show that the change in resistance produced by exposure to high temperatures is so great as to invalidate the usefulness of these instruments.

No. (4). Resistance increased ·046, which expressed as a portion of the original resistance = ·0046. Equivalent change of temperature = 1°·5. The last instrument therefore gives results which are sufficiently constant for industrial application if not for strictly scientific purposes.

Prof. Williamson suggested that the change in the resistance might be due to a change in the platinum, as it has been found that platinum in contact with silica, in a reducing atmosphere, is altered at high temperatures.

Report of the Committee appointed to prepare and print tables of Wave Numbers.

Mr. G. J. Stoney stated that the work of this Committee was in progress, and that the Committee hoped to be in a position to make a full report at the next meeting of the Association. Under these circumstances they merely asked to be reappointed.

Second Report on the Sub-Wealden Exploration. By H. Willett and W. Topley.

This Report gave an account of the progress of the work since the last meeting of the Association. Most of the results attained have been already made public through the Quarterly Reports, and they were recently summarised in these columns. At the time of the Bradford meeting only 300 feet had been reached, and the age of the beds then being traversed was unknown. Mr. Peyton and Prof. Phillips discovered Kimmeridge Clay fossils immediately after the Report was read; since that time a large collection of fossils has been made, including most of the characteristic English Kimmeridge species, and some which are new. An undescribed species of *Modiola* is very abundant, and so is a small *Astarte*—the *A. Mysis* of D'Orbigny. A new species of this genus has been found, and a small *Trigonia* which Dr. Lycett believes to be also new.

The Kimmeridge Clay appears to be nearly 700 feet thick; generally it is a rather sandy clay, but towards the base there are some thick bands of cement stone. The Coral Rag is apparently absent. Amongst the fossils from the Oxford Clay the following were noticed:—*Ammonites Jason, Am. Lamberti, Am. Sedgwicki, Pollicipes concinnus, Gervillia*, and *Macrodon*. The total depth now reached is 1,030 feet, and 3,000*l.* has been spent. The Association has voted an increased grant of 100*l.*, and the Government has promised aid to the extent of 100*l.* for each 100 feet completed below 1,000 feet; but as each 100 feet will cost from 300*l.* to 400*l.* (including the cost of lining the hole), the Committee trust that subscriptions will still be forthcoming to enable them to continue the work.

Report of the Committee on the Influence of Forests on Rain.—It appeared from the very lengthened report that the operations of the committee during the past year had been restricted to the meteorological observations made at Carnwath, Lanarkshire. In order to carry on the operations at Carnwath, and extend them, a grant from the Association of not less than 25*l.* would be required for next year. They did not propose to commence observations at any new station.

SCIENTIFIC SERIALS

The Journal of Mental Science, July 1874.—Dr. Nicolson proceeds with his Morbid Physiology of Criminals, discussing, on this occasion, prison discipline as a test of mind; and he finds a large number of prisoners who, tried by this test, he must class together as "weak-minded." In spite of his strong common sense, Dr. Nicolson at times betrays amiable leanings towards the hopeful rather than towards a perhaps unpalatable truth. We must confess ourselves among the "sceptics" from whom "the sight of a class of adult and veteran criminals plodding away at their books in the halls of a prison" "would but draw an ominous shake of the head." Granting that the book education of criminals could be carried further than there is any reason to believe possible, the assumption remains that this would tend more than any other form of discipline to make them less criminal than before—the only thing in which society has any special interest concerning them. The "weak-minded" criminal, being on the border line of sanity, is naturally a perplexing subject to the prison authorities. In dealing with him practically Dr. Nicolson's sagacity might be fully relied on, though in such expressions as "we can *punish* badness, but we must *treat* madness," there is implied a sharp line of distinction which exists only in our phraseology. Madness ought to be punished when that is the best treatment; and badness ought to be treated when treatment is the best remedy.—In an interesting paper, On children fostered by wild beasts, W. W. Ireland, M.D., favours the opinion that there is not a single authentic instance of the kind.—J. H. Balfour Browne, barrister, makes a psychological and medico-legal problem of the character of Léonce Miranda, the hero of Mr. Browning's Red Cotton Night-Cap Country; and by intensely commonplace standards of measurement concludes that Léonce was mad. We sincerely hope his principles of judgment will never find place in the deliberations of actual legal tribunals. It would be a terrible prospect to think that our wills might be set aside at the instance of greedy relatives on the ground that we were somewhat "anomalous," not exactly like the herd "in our mental constitution;" "to say which," says Mr. Balfour Browne, "is only to say that a man is insane." Perhaps "all the doctrines of Rome will not make a *practical* man who *professes* its creed believe in a nowadays miracle;" but what is the worth of the statement? Strike out the word *practical*, which here means stupid, and give the sentence definite meaning by substituting *believes* for *professes*, and the proposition becomes a contradiction in terms. But to be logical may be to be insane, according to the wisdom of our practical men who profess instead of believing.—The Morisonian Lectures; The treatment of insanity, abstracted from Drs. Bucknill and Tuke's chapter on that subject; Clinical notes and cases; Notes of the quarter, and reviews, make up the number. Dr. Carpenter's "Mental Physiology" is the most important review. His defence of the old free-will doctrine is severely handled; and an attempt, not quite so successful, is made to set aside the theory of unconscious cerebration.

Journal of the Franklin Institute, July.—Among the matter contained in this number is the first instalment of an elaborate paper by Mr. J. A. Henderson, M.E., On the theory of aero-steam engines, which, an editorial note informs us, is the first theoretical treatise on the subject that has appeared to complement the work of the late Prof. Rankine on other heat-engines. The "Principles of Shop Manipulation" is continued by Mr. J. Richards.—Chief Engineer W. H. Shock, U.S. Navy, under the head of "Strength of Materials," gives an account of a series of very carefully conducted experiments on bolts of various dimensions, under the two possible conditions—double cut and single cut—in which they might be used in connection with the bracing of boilers, and for other purposes.—There is a translation of M. Baudrimont's paper, On the tenacity of malleable metals at various temperatures.—Mr. C. J. Wister, in a paper On the moon's figure as obtained in the spectroscope, objects to Gussow's deductions from De la Rue's photographs of the moon at the extremes of her librations.—Prof. Thurston's paper On the mechanical properties of materials of construction, is continued.

The American Naturalist, August.—On the Flora of Southern Florida, by Frederick Brandel. The question considered is whether the flora of Southern Florida and the Keys is really North American or South Indian; and the conclusion reached is that it is not North American, but a link between it and that of the West Indies, and that a portion of those species which are peculiar to the northern portions of the State and the immediately adjacent region may have been derived from the south.—The Classification of the Rhynchophorous Coleoptera, by Dr. John L. Leconte.—Herbarium Cases, by Dr. C. C. Parry. A case is described, with a woodcut, specially designed for being readily moved.—A Key to the higher Algæ of the Atlantic Coast between Newfoundland and Florida, by Prof. D. S. Jordan. Part II. Rhodospermeæ. Part III. Chlorospermeæ. An etymology of names of genera is appended.—Under the section Zoology a new species of North American bird is described, named *Tringa ptilocnemis*.—In the Mammoth Cave Mr. A. S. Packard met with a new Japyx, to which he has given the specific name "*subterraneus*."

Astronomische Nachrichten, No. 2,003.—This number contains a paper by W. A. Rogers, of Harvard, On the orbit of the minor planet Felicitas (109). The elements and perturbations are given. Tacchini gives a number of observations of Coggia's comet, made with the meridian circle at Palermo. Schmidt also gives a list of observations of the position of the same comet for almost every night from May 3 to July 15. Schulhof gives several sets of elliptic elements for Coggia's comet, and it appears that it may be the same body as was seen in 1734, and so having a period of 137·1 years; or it may have a period of 12184·3 years, as shown by another set of elements. The author also adds an ephemeris from Aug. 31 to Oct. 6. D'Arrest also gives observations on this comet.—Dr. Zenker contributes a note On the light of the comet being polarised in a plane passing through the sun and comet, showing the presence of reflected sunlight.—Konkoly adds a note On the spectrum of the comet.

No. 2,004 contains a catalogue by Engelmann of the positions of fixed stars.—Pogson gives his observations on Biela's comet, made in November and December 1872. At Madras, on Nov. 2, at 17h. 31m. 1·3s. Madras mean time, its R.A. was 14h. 7m. 12·66s., and P.D. 124° 45′ 21·1″; and on Dec. 3, at 17h. 13m. 11·3s. its R.A. was 14h. 21m. 55·11s., and P.D. 124° 4′ 37·5″—Prof. Watson gives the elements and an ephemeris of Aethra (132).—Winnecke and Bruhns contribute notes on the positions of Borrelly's comet, and Dr. Holetschek has calculated the following element and ephemeris:—

T = Aug. 26.7199 Berlin time.

$$\pi = 343^\circ\ 57'\ 50''$$
$$\Omega = 251\ \ 44\ \ 18$$
$$i = 41\ \ 55\ \ 32$$
$$\text{Log.}\ q = 9\ 99292$$

	R A			D.	
	h.	m	s	°	′
Aug. 26 . .	12	33	48	+ 74	4 0
,, 30 . .	11	58	19	+ 74	20·7
Sept. 15 . .	9	50	27	+ 72	0 6
Oct. 1 . .	8	22	21	+ 66	17 0

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, Aug. 1.—The first article in this number is a statement by Capt. Hoffmeyer, director of the Royal Meteorological Institute at Copenhagen, of his plan, already noticed in NATURE, vol. x. p. 146, by Mr. R. H. Scott, for publishing daily weather charts for Europe and part of the Atlantic. It is here illustrated by a specimen chart. Next follows an examination by M. Raulin of the distribution of rain in Turkey in Europe and neighbouring parts. Observations were made at Pirano and Trieste between 1787 and 1807, and since 1841; in Corfu since 1845; at Ragusa since 1851; and at other stations, of which five are outside the peninsula, in later years. All the stations are near the margin of this large region, so that the weather of the interior is not yet well known. M. Raulin divides the year into two periods, a cold one from October to March, and a warm one from April to September. The practical significance of this division is that the rainfall of the warm period satisfies the immediate wants of vegetation, while that of the cold season goes mainly to the supply of wells and rivers. The rainfall at Fiume is very large, also at Ragusa, Janina, and Corfu, but very small at Athens and Smyrna. France has been divided into districts, each having its peculiar distribution of rain through the year, and the same method is adopted here. The first district, like the plain of Northern Europe, has more rain in summer than in winter, and includes Austria, Carinthia, Styria, Hungary, Southern Russia, and the Lower Danube, to Bucharest. Laibach belongs to the second district, having a rainfall steadily increasing from winter to autumn. To the third, with a very dry winter and summer and very wet autumn, belong St. Magdalena, Trieste, and Semlin. To the fourth, with a dry summer and rainy autumn, Dalmatia, Albania, Athens, Pera, and Scutari. Among the "Kleinere Mittheilungen" we have an interesting account of the climate of the Isthmus of Tehuantepec, from a report of the United States Government Survey Expedition; a notice of Herr Mohn's results derived from observations at Novaya Zemlya and Spitzbergen, made by Tobiesen, who died while wintering at the former place; and of Mr. Draper's paper, in which he shows the fears of a supposed change of climate in the Eastern States of North America to be groundless.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Aug. 24.—M. Bertrand in the chair. The following papers were read:—Ninth note on guano, by M. E. Chevreul.—Study of the fossil grain found in a silicified state in the coal formation of Saint-Etienne. Second part: Description of genera, by Ad. Brongniart. The author describes *Polylophospermum*, *Codonospermum*, *Stephanospermum*, and *Æthotesta*.—Note on the Central Sea of Algeria, by M. E. Roudaire. This is a reply to objections raised by MM. Fuchs and E. Cosson.—Researches on the effects of powder in fire-arms, by M. E. Sarrau.—On the passivity of iron; second note, by M. A. Renard.—Memoir on vegetable protoplasm, by M. Ganeau.—On some phenomena of localisation of mineral substances in the Articulata; physiological consequences of these facts, by M. E. Heckel. The author has been feeding insects with arsenic. The metallic powder was mixed with flour, and after repeated small doses the insects (*Mantis religiosa*, *Blatta occidentalis*, and *Cerambyx heros*) were killed and various parts of the intestinal tube examined. The Malpighian tubes only gave decided indications of arsenic.—Various communications on *Phylloxera vastatrix* were received from MM. Ador, Boutin, Rommier, Morlot, Barnier, and others.—On a new formula for obtaining by successive approximations the roots of an equation of which all the roots are real, by M. Laguerre.—On the direct combination of chromic acid with wool and silk; applications to the colouring and analysis of wines, by M. C. Jacquemin. M. C. Chevreul made some remarks on the foregoing paper.—On the ureides of pyruvic acid and its brominated derivatives, by M. E. Grimaux. Pyruvic acid heated with urea gives a substance of the formula $C_{13}H_{14}N_8O_4$. When excess of urea is employed the compound $C_{10}N_{16}N_8O_7$ is produced. With excess of acid another body is obtained, of which the composition has not yet been established. A nitro-body of the formula $C_{13}H_{10}N_8O_{11}$ has been prepared from these compounds, and likewise a ureide of tribrompyruvic acid of the formula $C_{10}H_8Br_6N_8O_6$.—Analyses of various pieces of calf flesh, mutton, and pork sold in the Paris market in 1873 and 1874, by M. Ch. Mène.—Anæsthesia produced by the injection of chloral into the veins for the removal of a cancerous tumour, by M. Oré.—Application of the graphical method to the determination of the mechanism of rejection in rumination, by M. J. A. Toussaint.—Note on the physiological action of apomorphine, by M. C. David. The author has experimented on dogs, cats, pigeons, rabbits, and guinea-pigs. The influence of various reagents on the alkaloid has also been studied.—Action of the sulphydric acid of the sources of the Luchon on granitic galleries, by M. F. Garrigou.—Observations of the Perseides made at the Observatory of Toulouse on August 5, 7, 8, and 9, 1874, by M. Gruey.—Observations made at Paris of the shooting stars of the month of August 1874; progress of the phemonenon from 1837 to 1874, by M. Chapelas.

CONTENTS

PAGE
FIFTH REPORT OF THE SCIENCE COMMISSION, II. 351
THE APPLICATION OF THE LAWS OF SELECTION TO AGRICULTURE. By Prof. THOMAS BALDWIN. 352
DARWIN'S "CORAL REEFS" 353
LETTERS TO THE EDITOR:—
The Long Peruvian Skull.—Prof. DANIEL WILSON 355
Pollen-grains in the Air.—HUBERT AIRY 355
Chrysomela Banksii.—J. TRAHERNE MOGGRIDGE 355
The Aurora Borealis.—HENRY R. PROCTER 355
ROBERT EDMOND GRANT, M.D., F.R.S. 355
CONFERENCE FOR MARITIME METEOROLOGY 356
DEEP-SEA SOUNDINGS IN THE PACIFIC OCEAN 356
PROCEEDINGS OF THE FRENCH ASSOCIATION. By W. DE FONVIELLE. 357
THE SIDEROSTAT (*With Illustrations*) 358
NOTES 359
THE BRITISH ASSOCIATION 361
ON THE HYPOTHESIS THAT ANIMALS ARE AUTOMATA, AND ITS HISTORY. By Prof. HUXLEY, F.R.S. 362
THE CARNIVOROUS HABITS OF PLANTS. By Dr. HOOKER, Pres. R.S. 366
BRITISH ASSOCIATION REPORTS 372
SCIENTIFIC SERIALS 373
SOCIETIES AND ACADEMIES 374

THURSDAY, SEPTEMBER 10, 1874

THE INTERNATIONAL CONGRESS OF ORIENTALISTS

THE International Congress of Orientalists, which is about to be held in London, from the 14th to the 19th of September, promises fairly to become one of the most striking events of the autumn. This philological parliament is the successor and outcome of a similar Congress held last year in Paris, which inaugurated a movement likely to bear good fruit for a long time to come. The idea of holding once during every year a meeting of this nature in a different city originated with M. Gabriel Mortillet, a distinguished French *savant*, who proposed an annual International Congress of Prehistoric Archæology. Of these, the first was held at Neuchâtel, in Switzerland, in 1866. At the Brussels Congress of this body, two monarchs, the Kings of Denmark and Sweden, commissioned agents to represent them on the occasion, and their example was followed by the municipal authorities of Bologna. The French Congress of Orientalists of 1873 was mainly due to the exertions of M. Léon de Rosny, who organised its machinery with the co-operation of MM. Madier de Montjau and Zelinsky. The most prominent considerations of this Congress were directed towards the Japanese Empire, history, and language, and a very large and extremely interesting mass of literary and scientific material was accumulated, and is now in course of publication and distribution among the members of that meeting. This collection of essays is all the more important when we consider how few really accurate channels of knowledge concerning that remote country are available to the European student. Although the French Congress was supported by a greater number of members than the approaching London Congress seems at present likely to enrol, nevertheless it was not well attended; for the principal Orientalists who occupy *fauteuils* in the Institute held aloof from various motives, while on the other hand the *savants* of Germany, in consequence of the recent war, were, however willing, yet prevented by the French national feeling from making their appearance in the capital city. Yet by far the larger number of the most eminent professors in Germany enrolled their names on the list of the supporters of the Congress.

The London Congress has, however, no difficulties of this nature to surmount, and it will without doubt show a great preponderance of learned Germans; at the same time a reference to the list of members indicates a very strong contingent from the other side of the Channel. The vital principle of these Congresses is, that each, at the conclusion of its labours, transmits its powers to a chosen individual who becomes president for the ensuing year; this president is elected after the country has been fixed upon in which the next meeting is to be held. The Paris Congress, in accordance with this principle, selected London, as the metropolis of England, to be the place where the Congress of the current year should be held; and this was done out of respect for the learning of the country, although very flattering and advantageous offers had been made by other European countries, which would have perhaps accorded an official reception more cordial than is likely to be given by the imperial authorities in this country. At the conclusion of the French Congress in September last year, Dr. Samuel Birch, K.R., Keeper of the Egyptian and Oriental Antiquities in the British Museum, a gentleman whose knowledge of the whole range of ancient remains, whether Greek, Roman, or Oriental, makes him *facile princeps* in this particular study, was elected president of the English meeting, and an executive committee was afterwards nominated to carry out the necessary arrangements. These preliminary matters are now so far advanced that the programme has just been issued, and the sittings, which will occupy the entire week, will commence on Monday next, the 14th inst. These Congresses are likely to produce several very excellent effects, by bringing together distinguished Orientalists who would probably not otherwise become personally acquainted with each other; by the mutual interchange of ideas, by the bringing about some understanding on many disputed points, and by the arrangement of some uniform system of transliteration and transcription of Oriental texts. But above all it will call public attention to the importance of Oriental studies, alas! too long neglected in Great Britain, and will elevate in public opinion the position of Oriental students and studies, which already exercise, and will hereafter still more powerfully exercise, an influence over European thought.

The number of English members is at present about 180, daily increasing and comprising all the names distinguished in Oriental studies; indeed, it would be difficult to mention any Orientalist of leading note in England who is not a member of this Congress. In addition to these, Prof. Dr. Brugsch will represent Egypt. France will be represented by upwards of thirty members, of whom we may mention M. François Lenormant, Professor of Archæology at the French Institute; Prof. Jules Oppert, whose labours on the Cuneiform languages are well known; and Prof. Léon de Rosny, who was president of the Congress last year. Germany is also well represented, sending such men as Prof. Brockhaus of Leipzig, a leading expounder of the old school of Sanscrit learning, with whom we may unite the name of Prof. Stenzler of Breslau; Prof. Dillmann of Berlin, chiefly known for his Ethiopic researches and his valuable lexicon and catalogues of Ethiopic MSS. in the British Museum and the Bodleian Library; Herr Euting, Librarian of Strassburg, who has specially studied Phœnician inscriptions; Prof. Haug of Munich, whose particular branch of study is the Sanscrit, Zend, and Pehlvi languages; Prof. Krehl of Leipzig, an illustrious Arabic scholar; Prof. Lepsius of Berlin, an Egyptologist of universal repute; Prof. Noldeke of Strassburg, who takes prominence for his knowledge of Arabic and Syriac, and has lately published works on the modern language of Syria; Herr Pertsch, Librarian of Gotha; Prof. Roth of Tubingen, whose Sanscrit Lexicon of the University of St. Petersburg is perhaps the best work of its kind; Prof. Spiegel, famed for deep studies in the Zend-Avesta and languages of Persia; Herr Trumpp of Munich, privat-docent, and lately appointed Professor of Arabic and Persian, who has published many works in the language of Afghan, Sindhi, and Punjabi; Prof. Weber of Berlin, a Sanscrit authority of the new school; Prof. Weil and Prof. Windisch, both of Heidelberg, the former noted for Arabic learning, the other for Sanscrit and Celtic studies.

The programme of meetings is as follows:—

Sept. 14.—Inaugural Meeting. With Address. 8.30 P.M., at the Royal Institution, 21, Albemarle Street. The meeting will commence with the election of the Council.

Sept. 15.—Semitic Section. President, Sir Henry Rawlinson, K.C.B. Secretary, W. S. Vaux, Esq., F.R.S. Sitting, 2.30 P.M., at the rooms of the Royal Society of Literature, 4, St. Martin's Place, Charing Cross.

Sept. 16.—Turanian Section. President, Sir Walter Elliot, K.C.S.I. Secretary, Prof. Douglas. Sitting, 8.30 P.M., at King's College, Strand.

Sept. 17.—Aryan Section. President, Prof. Max Müller. Secretary, Prof. Eggeling. Sitting, 2.30 P.M., at the Royal Institution, 21, Albemarle Street.

Sept. 17.—Hamitic Section. President, Dr. Birch, LL.D. Secretary, W. R. Cooper, Esq. Sitting, 8.30 P.M., at the rooms of the Society of Biblical Archæology, 9, Conduit Street.

Sept. 18.—Archæological Section. President, M. Grant Duff, Esq., M.P. Secretary, E. Thomas, Esq., F.R.S. Sitting, 11 A.M., at the rooms of the Royal Asiatic Society, 22, Albemarle Street.

Sept. 19.—Ethnological Section. President, Prof. Owen, C.B. Secretary, R. Cull, Esq., F.S.A. Sitting, 2 30 P.M., at the rooms of the Royal Asiatic Society, 22, Albemarle Street. At the close of the sitting the members of the Congress will decide in what country the next Congress shall be held, and will nominate the president.

There will be receptions on the following occasions:—

Sept. 15.—10 A.M., at the British Museum.

Sept. 16.—11 A.M. The Right Hon. Sir Bartle Frere will give a breakfast to the members of the Congress, at his residence, Wressil Lodge, Wimbledon.

Sept. 17.—10 A.M., at the India Office Library. 12 noon, at the Soane Museum.

Sept. 18.—Mr. Bosanquet will give an afternoon garden party to the members of the Congress, at his residence, Claymoor House, Enfield.

Sept. 19.—10 A.M., at the South Kensington Museum.

During the meeting of the Congress a Bureau will be opened at the Royal Asiatic Society's Rooms, 22, Albemarle Street, W., where every information concerning the Congress may be obtained.

The Committee of the Scientific Club have kindly invited the members of the Congress to make use of their club house, 7, Savile Row, W., during the session of the Congress. The foreign members of the Congress and their friends are invited by the Council of the Royal Botanic Society of London to visit the gardens of the Society, in Regent's Park, at any time during their stay in London. Such members will be admitted to the gardens by producing their cards of membership.

ANDERS JONAS ANGSTRÖM

ANDERS JONAS ANGSTRÖM, Professor of Physics in the University of Upsala, after a short illness of less than a fortnight, died, as we have already announced, on June 20, from an attack of inflammation of the brain. The death of Prof. Angström, who has been cut down in the full vigour of his powers and in the midst of a noble and active scientific career, is a loss to the entire world of science.

Angström was born Aug. 13, 1814, at the Lögdo Iron Works Settlement in Medelpad. He was the son of a pastor, who in the early childhood of Anders Jonas, removed to Ullånger, in Angermanland, and a few years afterwards to Sättna in the neighbourhood of Sandsvall, where he remained till his death in 1847. With no other means than the extremely limited stipend of a Swedish country minister, supplemented by the proceeds of a small glebe, the elder Angström kept his three sons—the present Dr. Johan Angström and Prof. Anders Jonas and his young brother Carl Arendt at school, and even assisted them in their subsequent attendance at the University classes at Upsala. In these efforts the father was strenuously supported by his wife, without whose good management such efforts would have been impracticable; and to advanced age this admirable housewife continued to prosecute her daily task of spinning, without remitting her active supervision of her household.

Although circumstances compelled Angström to eke out the means necessary for his University course by his own exertions, he passed through all his requisite examinations with distinction and within the usual terms. After matriculating in the autumn of 1833, he took the degree of Doctor of Philosophy in 1839; became a physical tutor in the same year, and assistant in practical astronomy in 1843; while in the years 1846 and 1847 he fulfilled the duties of the Chair of Astronomy at the University, during the temporary absence on the continent of the professor. Owing to want of interest he had, however, five years to wait before he obtained any other fixed employment. The Chair of Physics had fallen vacant in 1839, the same year in which Angström graduated; but then, and for some time afterwards, his abilities were not fully recognised in the University, while with his natural modesty he abstained from presenting himself as a candidate, although he might then have enjoyed the same good fortune as his friend and fellow-student, Malmsten, who, after having had four years in which to prepare himself, was able on the death of the Professor of Mathematics, in the year 1843, to offer himself as a successful candidate for the vacant chair. At length, in 1858, on the public recommendation of the Consistory, Angström was nominated to the Chair of Physics, the duties of which he had performed for two years in the character of a *pro tempore* professor. This chair he continued to hold for the remaining sixteen years of his life.

During his occupancy of the chair Angström secured for the physical museum of the University an admirable collection of instruments for the determination of different exact measurements in the various departments of physical science; and as far as the limited resources at his disposal permitted, he improved the physical laboratories, and strove to awaken amongst the students an interest in the study of the exact sciences. He also continued for a number of years, in the capacity of Secretary to the Royal Society at Upsala, to conduct its transactions with a zeal and devotion which secured for him the grateful recognition of foreigners as well as of his own countrymen.

Although Angström published memoirs on almost all branches of physical science, his name will be for ever associated with the history of spectral analysis, for which he obtained from the Royal Society of London in 1870 the Rumford gold medal, a distinction which no Swede had ever before enjoyed.

In order to show Angström's place in scientific history in regard to this class of researches, it will be well in this place to briefly recapitulate the capital points.*

---

* This recapitulation is based upon the historical statement in Lockyer's "Solar Physics."

Fraunhofer, at the beginning of this century, pointed out the coincidence of place in the spectrum between certain dark lines which he saw in the spectrum of the sun and the bright lines in the spectrum of the flame of a lamp. In Dr. Brewster's note-book, dated St. Andrews, Oct. 28, 1841, this passage occurs:—"I have this evening discovered the remarkable fact that, in the combustion of nitre upon charcoal, there are definite bright rays corresponding to the double lines of A and B, and the group of lines *a* in the space A B. *The coincidence of two yellow rays with the two deficient ones at* D, *with the existence of definite bright rays in the nitre flame, not only at* D *but at* A, *a and* B, *is so extraordinary that it indicates some regular connection between the two classes of phenomena.*"

We next have an important experiment made by Foucault in 1849, who pointed out that the electric arc presented us with a medium which emits the rays D on its own account, and which at the same time absorbs them when they come from another quarter.

The received explanation of this coincidence between the two bright lines of burning sodium vapour, and the two dark lines D in the solar spectrum, which extended the grasp of spectrum analysis from terrestrial substances to the skies, was taught by Prof. Stokes in his lectures about 1852, but was not published.

In 1853 the idea was first published by Angström.*

In his memoir, for the purpose of illustrating the absorption of light, he made use of a principle already propounded by Euler, in his *Theoria lucis et caloris*, that the particles of a body, *in consequence of resonance*, absorb principally those ethereal undulatory motions which have previously been impressed upon them. He also endeavoured to show that *a body in a state of glowing heat emits just the same kinds of light and heat which it absorbs under the same circumstances.* He further undertook researches on the electric light, and stated that in many cases the Fraunhofer lines were an inversion of the bright lines, which he observed in the spectrum of various metals.

Early in 1859, Mr. Balfour Stewart independently discovered the law which binds together radiation and absorption, establishing it experimentally as an extension of Prévost's law of exchanges in the case of the heat rays, and generalising his conclusion for all rays.

In October of the same year, 1859, Kirchhoff established experimentally the same law for the light rays.

On the occasion of Angstrom's admission to the membership of the Royal Society, General Sabine in his introductory address mentioned that the obstacles opposed by the language in which Angstrom's treatise had been written, and by distance from the scene of his investigations, had for three years prevented its very existence from being known to the scientific world at large; but when once the nature of that treatise became known, the fact was immediately acknowledged, that in Professors Stokes and Angstrom we are bound to recognise the fathers of spectral analysis. Indeed, in the "Optiska Undersokningar" of the latter are to be found many of the fundamental principles of much that has since been accomplished in that department of scientific inquiry. In his work entitled "Recherches sur le spectre solaire," with its atlas of the normal spectrum of the sun, Angström has given us an indispensable adjunct for all future students of spectrum analytical investigations.

We have already stated that Angström published memoirs on subjects connected with nearly every department of physical inquiry. Thus we have papers:—(1) "Sur la polarisation rectiligne et la double réfraction des cristaux à trois axes obliques" (Upsala Vetenskaps-Societets Acta), in which he gives the solution of the problem involved in the optical phenomena presented by such crystals which had been sought, but without success, by Neumann and MacCullogh. (2) On the "Monoklinoedriska kristallernas molekulara Constanter" (Vet. Akad.'s Handlingar, 1859). (3) "Ny metod at bestamma kroppars ledningsformaga for Varme"—New method of determining the capacity for conducting heat in the human body—(Vet. Akad. Förh. 1861); which contains the first determinations ever given of the absolute values of the capacity for conducting heat. (4) "Sur deux inégalités d'une grandeur remarquable dans les apparitions de la Comète de Halley" (Upsala Vet. Soc. Acta.). This treatise first excited the expectation amongst astronomers of obtaining certain results by means of a single method. (5) "Sur les Spectres des gas simples" (*Comptes Rendus*, 1871).

These are among the most important of Angström's numerous treatises, and in addition we may instance his celebrated monograph, "Mémoire sur la temperature de la terre" (Upsala Vet. Soc.'s Acta.), as well as a paper belonging to an earlier period, which appeared in the "Denkschriften der Munchener Academie," 1844, under the title of "Magnetische Beobachtungen bei Gelegenheit einer Reise nach Deutschland und Frankreich."

As might naturally be expected, numerous scientific Societies sought the honour of numbering Angstrom amongst their members, as for instance:—Kungl. Vet. Akad. i. Stockholm; Kungl. Vet. Akad. i. Upsala; the Royal Societies of Berlin, Copenhagen, London, &c. He was, moreover, appointed Corresponding Member of the French Institute; he twice obtained the Wallmarsk prize of the Vet. Akad. of Stockholm in 1865, in conjunction with Professors Thalén and H. Holmgren, and in 1869 with the former alone. He carried off two other prizes given by the same Society, and once he obtained a grant of money for his observations from the University of Upsala, before he had become a member of the Upsala Vet. Soc., which was the more acceptable to him, since for a long period he reaped a very inadequate pecuniary return for his scientific labours. Partly by the aid of the State, but mostly at his own personal expense, Angstrom several times visited the Continent, especially France and Germany. He was absent from Sweden in the years 1843, 1844, 1859, and during the summers of 1866 and 1867; but with one exception he attended all the meetings of the Scandinavian Association for Natural and Physical History. In recognition of his great merits, Angstrom was made Knight of the "Order of the North," and Commander of the Vasa Order 1st Class, and of the "Crown of Italy."

THE IRON AND STEEL INSTITUTE

THIS prosperous and useful association held its sixth summer meeting last week, from the 1st to the 4th instant, at Barrow-in-Furness, a town whose rapidity of growth is unparalleled out of America. Twenty-five years ago the village of Barrow, near the southern extremity of the peninsula of Furness, in Lancashire, had a population of barely 200; now the municipal borough extends over an area of about 15,000 acres, with a population of about 35,000. Even fourteen years ago, when the first volume of *Chambers' Encyclopædia* was published, it seems to have been so little known, or of so little importance, as not to find a place in that useful work. It is now a well-laid-out town, with fine docks, and some of the most important iron and engineering works in the kingdom; while one of the steel works are considered to occupy a leading position in connection with the manufacture of Bessemer steel. This unequalled growth of the town of Barrow is entirely owing to the rapid development of the various industries connected with iron, the mineral deposits of the district being unusually rich.

---

* "Optiska Undersokningar." Trans. Royal Academy of Stockholm, 1853. Translated in Phil. Mag. 4th series, vol. ix. p. 327.

Such a town forms an appropriate meeting-place for an Institute which has done so much to develop the manufacture of iron and steel, by affording a medium for the interchange of ideas between those who are engaged in the practical work of these industries or in the investigation of the scientific principles on which they must be founded if they are to be successful. The Institute is to be congratulated on the scientific tone which has all along pervaded its proceedings and its publications since it was founded in 1869. Though it has had such a comparatively short existence, it seems to have been in all respects prosperous (it now numbers close on 600 members), and to have most satisfactorily fulfilled the purpose for which it was instituted, the improvement of the all-important manufacture of iron and steel by the free interchange of ideas generated by experience or scientific study. To quote the words of our contemporary *Iron*: "Anterior to the establishment of this important society, the manufacturers of iron in its various forms had scant opportunity of communicating in public the results of their own experience, and of comparing those results with the observations of other persons equally interested in their development. Various methods of working prevailed in different parts of the country, and not long ago many processes connected with iron and steel manufacture were regarded as trade secrets to be carefully treasured up and jealously guarded. To the abolition of these narrow and antiquated notions the Iron and Steel Institute addressed itself vigorously from its very inception. It soon became apparent that among the first promoters of the society there prevailed an earnest desire to cast aside all petty jealousy, and to add unreservedly their individual knowledge to the general stock of information. Adherence to this excellent principle produced a prompt effect on the minds of iron and steel makers in all parts of the British Empire, and secured the sympathy of continental and American manufacturers." This is a very valuable result to have been accomplished in so short a time, and may perhaps partly be accounted for by the high scientific character of those who have from the first been elected to hold office in the society. With such names on its list of office-bearers as his Grace the Duke of Devonshire, Mr. Isaac Lowthian Bell, F.R.S., Mr. Bessemer, Mr. John Jones, F.G.S. (general secretary), Mr. David Forbes, F.R.S. (foreign secretary), Dr. C. W. Siemens, F.R.S., and others, the Institute has every chance of doing good work and of imbuing its members with a feeling of the necessity, in order to secure the highest success in their important industry, of importing into it continually the results of the latest and highest scientific research. There is little fear of the practical side of the iron and steel manufacture being neglected; and if this as well as other similar Institutes, do their work faithfully, and if the members enter upon their work equipped with a thorough scientific as well as professional training, there will be little fear of other nations outstripping us in this, as they threaten to do in other industries. To keep up the tone of the Institute, the importance of electing right men to hold office in it cannot be too much insisted on, and we hope that in this respect it will go on as it has begun.

The Barrow meeting seems to have been a real success; the only complaint being, as is almost always the case at such meetings, the difficulty of getting sleeping accommodation for the members; in Barrow this is not to be wondered at, as the people have scarcely had time yet to think about building hotels. The Duke of Devonshire, who is intimately connected with Barrow, the Earl of Lonsdale, the Mayor, and other dignitaries, as well as the railway companies and proprietors of the numerous works in and around Barrow, entertained the members most hospitably, and gave them every opportunity of inspecting the working of the numerous vast establishments connected with the industries with which the Institute is concerned. Indeed, the greater part of the four days seems to have been spent in visits and excursions; and considering the nature and aims of the Institute, its time could not, perhaps, have been more profitably spent. A good many papers were also read, all of them of considerable practical value, but of too purely technical a nature for these columns. Among the more generally scientific we may mention Mr. Wurzburger's very interesting and well-informed paper on the Geology of the West Coast Iron Ore Districts, and Mr. Charles Smith's paper on the Iron Ores of Sweden. The last day, September 4, was entirely devoted to an inspection of various mining works in the West Cumberland district.

Altogether we have no doubt that the members of the Institute will look back upon the Barrow meeting as one of the pleasantest and most instructive they have had. The Right Hon. Earl Granville has been elected president for the years 1874-6.

SHARPE'S "BIRDS IN THE BRITISH MUSEUM"

Catalogue of the Birds in the British Museum. Vol. I.—Accipitres. By R. Bowdler Sharpe. (Printed by order of the Trustees.)

THE great value of Dr. Günther's "Catalogue of Fishes" in the British Museum is appreciated by all working zoologists; and when Mr. Sharpe was appointed one of the Senior Assistants in the Natural History Department of that noble institution, ornithologists had every reason to hope for an equally important work on the birds in the same collection, all fully realising Mr. Sharpe's perfect competency for the execution of so arduous a task. The volume before us shows [illegible] hopes were not misplaced. The "Hand-List of Birds," by the late Mr. G. R. Gray, invaluable as it is on account of its extensive indexes and easy method of reference, has a very definite and narrow limit of utility; it is an essential supplement to a library, but gives no detailed information itself. The work before us has a very different scope. Besides the nomenclature and the synonymy of the whole bird-class, it will contain the complete description of each species from the hand of one of our most able and enthusiastic ornithologists, based upon the finest collection in the world, the deficiencies of which, through the liberality of the trustees and the energy of its superintendent, are being so rapidly diminished, that, as we are told in the introduction, of the 354 certain species of diurnal birds of prey at present known, less than thirty are desiderata in the collection. Woodcuts, scattered through the volume, help to illustrate many of the peculiarities of the heads, tarsi, and toes of the species to which they refer; whilst twenty or so coloured plates, from the pencil of Mr. Keulemanns, assist in indicating the special characters of type-specimens and rare forms.

A glance through the work tends strongly to confirm our prejudice against the existing rules of avian nomenclature, and makes us hope that before long some improvement in the direction of simplification will be adopted. The system of Linnæus was a binominal one, no doubt; but though that at present in vogue still retains that name, it has gradually drifted into a quadrinominal system. The number of species of birds is certainly large, but hardly beyond the grasp of a binominal nomenclature. As it is, each bird receives its two Latin names, generic and specific, added to which is that of the author who originally described it as such, in brackets or not, according to whether he placed it in some other genus or in the one in which it is retained. Could not some universal congress be formed to determine once for all a name for each species, based on the laws of priority, present knowledge, and euphony, and so fix the appellation of all now known birds, as a starting-point for future workers, so that it need no longer be felt that the publication of every new book which has any pretension to sound work will bring with it changes in the naming of even our most familiar species, which are as confusing as they are unimportant? In the work before us the well-known smallest of the diurnal birds of prey is shown to have to be placed in a new genus, *Microhierax*, instead of retaining its habitual name *Hierax*, whilst the King Condor must in future be *Cathartes* instead of *Gyparchus*, the Black Buzzard changing to *Catharistes* or *Catharista*, according to the appreciation of gender in the author transcribing it.

The Turkey Buzzard fares still worse. Its generic distinctness from the last-mentioned bird must have struck Mr. Ridgeway in the United States and Mr. Sharpe in this country almost simultaneously. Both authors must have had the works in which they announce their proposed change in proof at the same time. The "History of North American Birds," however, appeared shortly before the volume under present review, and consequently the still-born *Œnops* has to sink into a synonym of *Rhinogryphus*. A similar fate has awaited *Urubitinga unicincta*, which will have to stand as *Antenor* instead of *Erythrocnema*. Among other fresh genera we find *Lopho-*[illegible], which includes *Spizaëtus kieneri* and *S. isidorii*; and *Urotri*[illegible] containing only *Astur macrurus*; and others. With regard to [illegible] Mr. Sharpe has separated off the smaller brown Condor as [illegible] *æquatorialis*; the Turkey Buzzard, with yellow head and whi[illegible]ides, as *R. pernigra*; an *Astur*, obtained by Mr. Wallace in Lombock and Bouru, as *A. wallacii*; and a Falcon, which Prince Bonaparte and Prof. Schlegel consider a melanism of *F. severus*, as *F. religiosus*.

Next with regard to the classification which is adopted; as the work does not profess to be more than a catalogue and a key for the identification of the species, it would not be fair to expect that in the separation of the different families and genera described all the known peculiarities should be given; sufficient for the ready identification of each being all that is required. Consequently when the sub-family *Polyborinæ* of the family *Falconidæ* is divided up as in the following table, without any further definition, it is evident that the author only attempts to give a minimum, and not a maximum number of distinguishing features.

POLYBORINÆ.

Key to the Genera.

a. Middle tail-feathers not elongated.
- *a'*. Nostrils oval . . . . POLYBORUS.
- *b'*. Nostrils round . . . IBICTER.

b. Middle tail-feathers extremely elongated; head with elongated plumes.
- *a'*. Nostrils vertical ovals; forehead with erect crest . . . . . . CARIAMA.
- *b'*. Nostrils perpendicular ovals; forehead not crested . . . . . SERPENTARIUS.

In the above instance we are astonished, as many others will no doubt be, not so much at the slightness of the differentiation of the genera, as at the fact that *Cariama* and *Serpentarius* are placed in such intimate relation with the Caracaras. The illustrious Nitzsch, whose opinions on classification are more to be relied on than those of any other zoologist, it is true, placed the Secretary Bird with the Accipitres, though he retained the Cariama with the Bustards. More recently there has been a tendency, which is daily becoming stronger, to combine the one with the other. The question then arises, are they Bustards or are they birds of prey? Internal structure is overpoweringly in favour of the former position; and such being the case, it is almost to be regretted that no further notice has been taken by Mr. Sharpe of their peculiarities than the statement that in two out of the four genera of the Polyborinæ, the median tail feathers are elongate, whilst in the other two they are short, especially when *Pandion* is placed in a sub-order by itself; and, as it happens, has its foot accidentally represented without the ungual phalanges or any of the three anterior toes. For though *Serpentarius* presents strongly marked external facial resemblances to *Polyborus*, which, by the way, are not to be found in *Cariama*, nevertheless in other respects they both differ so much from all other true Accipitres, that it would be impossible, even if they were birds of prey, to do otherwise than place them in a sub-order by themselves; which is the same thing as saying that their relationship to the Caracaras is not more intimate than to the eagles and the hawks.

Similarly, the American Vultures, or C[illegible]dae, if they are vultures at all, which is [illegible]ely improbable, can hardly be included in the same family with their typically accipitrine [illegible]kes, but must be placed independently by themselves. The conformation of the feet alone, and more especially the difference in the proportionate length of the phalanges pointed out by Prof. Huxley, is alone sufficient to decide this point.

Leaving these minor points out of the question, however, as having little or no bearing on the true value of the whole, we look on the volume before us as the precursor of others, which if all completed in the same thorough and able manner that is throughout manifested in the first, will form a standard ornithological work, the importance of which it will be impossible to overestimate. We wish Mr. Sharpe all success in the further prosecution of his almost herculean task.

OUR BOOK SHELF

1. *The Principal Timber Trees.* 2. *Select Plants (exclusive of timber trees).* 3. *Additions to the Lists of the principal Timber Trees and other Select Plants readily eligible for Victorian Industrial Culture.* By Baron Ferd. von Mueller. (Melbourne.)

THESE papers, drawn up by Baron Mueller, and first published in the Proceedings of the Zoological and Acclimatisation Society of Victoria, are something more than mere lists, inasmuch as in their separate pamphlet form, in which form they have all since been issued, the first occupies 58 pp. 8vo, and was issued in 1871; the second, 428 pp. 8vo, issued in 1872; and the third, the "Additions," 40 pp. 8vo, issued only a month or two since, and only just come to hand.

It is not on account of any original observation being made into the properties or uses of the trees or plants enumerated that we think these papers worthy of notice, but rather on account of their practical use in imparting to an unscientific colonist a knowledge, not only of such trees and other plants as may grow in the climate, but also of their value in an economic or commercial point of view. By means of a pamphlet like either of the above, we have ready references to plants, natives of nearly every part of the globe, which are, moreover, with some authority considered suitable for acclimatisation in Australia and other countries. Such information as the geographical distribution, habit of the plant, &c., could only be obtained by reference to the numerous Floras and bulky botanical works which are as sealed books to the colonists generally, while the economic applications would have to be sought for in numerous other and totally distinct works, for our Colonial Floras seldom or never even touch on this important part of the subject. Baron Mueller, indeed, says that these lists are intended not so much to contain records of original research as "to bring together information more condensed and more recent than would be attainable in costly or voluminous works of even several languages."

The arrangement of the genera is alphabetical instead of being scientific, and the following examples will show the sort of information given:—

"*Buxus semper virens* L.—The Turkey Box Tree. South Europe, North Africa, South-west Asia. This slow-growing tree should be timely planted to provide the indispensable box-wood for wood-engravers and musical instrument makers, as yet no good substitute for it having been discovered. The box tree needs calcareous soil for its [illegible]opment. Among allied species, *B. balearica* attains a height of eighty feet."

Then follows a list of other species of *Buxus*, about which, however, little is known as to the value of the respective woods. Here is another example, taken haphazard:—

"*Guevina avellana* Molina.—Extends from Middle Chili to the Chonos Archipelago. Briefly alluded to already in the list of trees desirable for Victorian forest culture. One of the most beautiful trees in existence. The snowy white flower-spikes produced simultaneously with the ripening of the coral-red fruit. In the cooler southern regions the tree attains considerable dimensions. The wood, tough and elastic, used for boat-building. The fruit of the allied *Brabejum stellatifolium* can only be utilised with caution in a roasted state as an article of diet, because it is noxious, or even absolutely poisonous, in a raw state."

Guevina avellana is a Proteaceous tree, the fruits of which are very similar in appearance, and the seeds very similar in flavour, to those of the Australian tree *Macadamia ternifolia*. These lists will probably prove useful not only as a guide to the selection of plants for the purposes of acclimatisation, but also as a handy reference for economic species generally.

J. R. J.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

A Remarkable Thunderstorm

[The following letter has been forwarded to us for publication by Mr. R. H. Scott, F.R.S.—ED.]

"Yorkshire Philosophical Society,
York, Sept. 2, 1874.

"Dear Sir,—I have to report to-day one of the most unusual thunderstorms that I ever remember. It began to be dark about 12 30 noon, and rain fell; at 12.40 it was much darker; at 12 43 rain fell in torrents, but was so much driven by the wind that you saw it being driven like snow in packs; so dense was it now and for ten minutes that I could not see chimney-pots 100 yards distant. The thermometer must have fallen tremendously, for windows were so steamed inside as to be opaque. I remarked that the clouds went in the direction of N.W., while the wind was S.S.W., and force about 8. Part of the time it went in whirlpools, as it were; during the climax of ten minutes we had rain with lightning and thunder, then snow, and snow and sleet, and distinct hail afterwards, but not of large size.

"I should have taken the state of the instruments, but I was about half a mile from the museum.—I am, &c.,

(Signed) "C. WAKEFIELD

"R. H. Scott, Esq., F.R.S.,
"Director, Meteorological Office.

"P.S.—Rain measures ·49. There was lightning (a little forked, the rest sheet) and thunder during all the storm."

The Exhibition of Specimens and Apparatus at the British Association

IF no one else has already done so, will you permit me to call attention to the valuable feature of the Belfast meeting of the British Association presented by the exhibition of specimens, apparatus, and diagrams in the Anatomical Museum, due, it is understood, to the energy and perseverance of Mr. Ray Lankester. Here were to be seen, for instance, Mr. Symons's series of thermometers illustrating variations in sensibility, a collection of bones and other remains found in Kent's Hole and the Victoria Cave, during 1873–74, Dr. Pye Smith's large undescribed Medusa, the diagrams and plants which illustrated Dr. Hooker's address on Carnivorous Plants, specimens of breech-loading fire-arms, and many other objects of interest, all catalogued in each day's issue of the "Journal." It is to be hoped that a similar collection, rendered still more complete through the co-operation of the authors of papers, will be an addition to the attractions of all future meetings of the Association.

Penmaenmawr, Sept. 4 ALFRED W. BENNETT

Photographic Irradiation

IN NATURE, vol. x. p. 245, Mr. W. C. Crofts adds his experience to those previously given in your journal, and gives his conclusion as opposed to that of Mr. Aitken (vol. x. p. 185). Like most conclusions based on incomplete evidence, it does not conclude anything. The fact is as I have stated it in my previous note (vol. x. p. 205) on the subject, and when I return to England I will be most happy to demonstrate it to anyone who cares to examine the question thoroughly. Mr. Crofts' experience with the Liverpool dry plates agrees with my own, for these plates are prepared with a pyroxyline which gives a minimum of irradiation when "backed," and give the best quality of image for scientific purposes attainable with a bromide film; but certain qualities of pyroxyline prepared in precisely the same way will show irradiation that nothing can cure, even when used for making transparencies by contact, where, of course, there can be no question of influence of any optical defects. The unquestionable fact that a collodio-albumen film acts in so totally different a manner from one of bromized collodion should prove that the lens has next to nothing to do with it.

My conclusions may be very imperfect, but so far as they go they are definite, and are drawn, not from two or three, but from hundreds of experiments with all kinds of dry plates and many different samples of pyroxyline, and whatever they may be worth, they fully support Mr. Aitken's views.

New York, Aug. 19 W. J. STILLMAN.

Pfluger on the "Salivary Glands" of the Cockroach

I WAS much interested in reading Prof. Redfern's able address at the British Association this year, more especially with that portion which dealt with the observations of Prof. Pfluger on the histology of the so-called "salivary glands" of the cockroach. In the year 1871 I wrote a short paper in Professors Humphry and Turner's Journal (vol. v. p. 242 *et seq.*) upon these organs. In this I ventured to doubt the truth of the generally accepted hypothesis as to their functions. My reasons for so doing may be summarised as follows:—1. The appendages in question are perforated throughout by ramifying spirally coated tubules differing only from tracheæ in this respect; during their passage through the organs in question they receive a layer externally of yellowish tissue, which may be, as Prof. Pfluger suggests, epithelial glandular tissue. 2. These tubules with the sacculi opening into them can be more or less fully injected with a liquid by simply immersing the insect in a suitable menstruum, and placing it under the exhausting receiver of an air-pump. This experiment demonstrates indubitably that this tubular system contains an *elastic fluid*, which for anatomical and other reasons I conclude to be air. 3. As far as my experience carried me, the sacculi, the supposed reservoirs of the saliva, never contained naturally any liquid whatever, but upon opening the thorax were invariably found to be collapsed and apparently empty. This is precisely what would occur supposing that during life they were filled by and communicated readily with the external air.

I have not yet had an opportunity of referring to Prof. Pfluger's paper, and I am consequently obliged to accept his statements at second hand. In noticing the intimate connection there is between these organs and the nervous system of the insect, he confirms what I have myself observed. It is some years since I last anatomised a cockroach, and meanwhile I suppose these insects have utilised their organs in the way mentioned by Prof. Pfluger, and we can now see "transparent drops . . . transuding from the ends of cells when the saliva has been made to flow by irritation of the gland." On looking over my microscopic specimens I find that I still have by me one showing the so-called "salivary duct" and a sacculus injected in the way I have mentioned. Any one may satisfy himself that this result is feasible by trying the experiment. In doing so the only caution required is to exhaust the air gradually and to keep the immersed insect in a partial vacuum for a few hours. Failure under these circumstances is almost impossible.

London, Sept. 2 W. AINSLIE HOLLIS

THE CONFERENCE FOR MARITIME METEOROLOGY

THE Conference, held at the Meteorological Office, 116, Victoria Street, for the purpose of reconsidering the decisions regarding maritime meteorology made at the Brussels Conference in 1853, has concluded its sittings, and the Report of its proceedings will be presented to the Permanent Committee, appointed by the Meteorological Congress of Vienna (of 1873), which holds its meeting at Utrecht in the course of the present week. The Conference consisted of twenty-five members, belonging respectively to every maritime country of consequence in Europe, except Sweden and Turkey. India and China were also represented. Prof. Buys Ballot was elected president, and Capt. Hoffmeyer and Mr. Scott, F.R.S., secretaries. It met on the 31st ult., and at once subdivided itself into two sub-committees, dealing with the various questions connected with (1) "Observations," and (2) "Discussions." Each sub-committee held four sittings, and at the closing meeting of the Conference the several resolutions framed by the sub-committees were adopted, in most cases unanimously. Inasmuch as the Conference was an outcome of the Vienna Congress, these resolutions will not be published until they have been communicated to the Permanent Committee as above mentioned. Their general scope is towards the attainment of greater uniformity in the methods of meteorological observation at sea, and of subsequent publication of the results. On Thursday, by kind permission of the Astronomer-Royal, the members went to Greenwich in the morning, where they were conducted over the magnetical and meteorological department by Mr. J. Glaisher, F.R.S. In the afternoon they spent some hours at Kew Observatory, where they were received by Mr. Jeffery, the superintendent, and in the evening the whole party was entertained at dinner at the Star and Garter, by some of the members of the Meteorological Committee. On Friday several members availed themselves of the great courtesy of the War Office, and repaired to Woolwich, where they were conducted over the Arsenal by Colonel Field and other officers connected with that department. Finally, on Saturday, they inspected the Meteorological Office, where the meetings of the Conference had been held, and paid special attention to the arrangements there existing for reproducing the records of the photographic and other instruments at the several observatories in the United Kingdom.

ON SEWAGE AND SEWAGE FARMING

No. 1.—*Northampton.*

AFTER having had practical experience of the fertilising effects of sewage and liquid manure, I have for several years devoted part of my leisure time to an examination of the arrangements adopted by the principal cities and towns for disposing of sewage. At first I looked at it from the agricultural stand-point; but as I proceeded with the inquiry I had to widen the range of view.

The place I visited last is Northampton. I propose at present to write a concise note of what the authorities of that town have done.

Northampton has a Board of Commissioners for dealing with sewage and kindred nuisances, which is distinct from the corporation. I believe their number is limited to twelve; of whom six belong to one political body, and six to the other. These twelve Commissioners, as a body, must, therefore, be non-political; six of one being equal to half-a-dozen of another.

The town contains at present about 50,000 people. Many experiments were made at the expense of this body for purifying the sewage. At last they adopted the scheme which I proceed to describe.

Near the town there is a number of tanks in which the sewage is allowed to settle for some time so as to enable the more bulky of its solid contents to fall to the bottom and be collected. Deprived of these solid matters, the sewage is conveyed in a main culvert, about four miles from the town, where it is received on a tract of ground containing upwards of 300 acres, which was purchased at a cost of 130*l.* an acre. I may mention that all the figures were obligingly communicated to me, verbally, by the chief officer of the Commissioners. Up to the present the outlay has amounted to upwards of 84,000*l.* The soil is not naturally the best adapted for sewage-farming; it does not, however, offer any insuperable obstacle to success. The sewage is received at the highest point of the farm, from which it flows by gravitation to the lowest, which is several feet below the river that runs by, and into which the sewage passes after it has undergone clarification.

The sewage is distributed over the farm by a simple system of carriers, and it is used mainly for irrigation. After it goes over one plot it flows to another, and so onwards. At the lowest part of the farm a permanent plot of osiers has been planted; the intention being that this plot will serve as a filter-bed for abstracting from the sewage all offending material which is not taken out by irrigation. After percolating through the soil of this osier-bed, the clarified sewage is received in a second, or outlet culvert, which is about two miles long, and in which the fall—one foot per mile—is less than that of the river.

Under cultivated crops of all kinds at the present time, there are about 100 acres. There is one good plot or field of Italian rye-grass; one good, and one indifferent plot of mangold wurzel; and one good plot of beans. A large field of Italian rye-grass has utterly failed, and in its place grew a luxuriant crop of weeds, which would have proved an attractive feature in a botanic garden. There are other failures on which it is useless to dwell.

The land is not farmed in what could be called a skilful manner; indeed, the engineer frankly said that up to the present, farming had been a secondary object with the Commissioners.

The greater part of the uncropped land has been recently purchased. It is now being prepared for the sewage at a cost which will doubtless exceed 20*l.* an acre. I cannot help thinking that a simpler scheme would answer equally well for irrigation.

It will be understood at once that the inhabitants of Northampton have been rid of the abominable stench which the sewage formerly inflicted on them. But there remain for consideration two points of very great importance to the people who live along the river below the sewage farm. In the first place, if the sewage be not deprived of its organic impurities on the farm, it must, on mixing again with the river, cause a fresh nuisance. That the people do think so is evidenced in a newspaper report which lies before me; and judging from what I saw of the effluent water, I can sympathise with these people. I took a small bottle of this water, which I find contains a large quantity of organic matter. As it went on the osier-bed it was still sewage most unmistakeably; and when the pores of this bed—this so-called filter bed—become full of the organic impurities, as they soon must, the complaints will become louder and louder, and justly so.

I have a second objection to the arrangements here adopted, and it is this: What guarantee is there that the *contagium* of any infectious disease which may be in the sewage is destroyed? That *some* of it would be oxidised or destroyed in flowing over the ground is certain; but the necessities of the case require that the whole of it should be destroyed. I have made experiments which prove conclusively that the contagium of infectious cattle diseases is not destroyed in flowing over land, nor in passing through such a filter as is here provided; and as there is no evidence to show that the contagious principle of human infectious diseases is not equally active, it cannot be said that the Commissioners of Northampton have satisfactorily disposed of the sewage of that town.

THOMAS BALDWIN

NOTES

WE take the following from the New York *Nation* of Aug. 20:—"The American Association for the Advancement of Science has held its annual meeting at Hartford during the past and present week. The most important business before the meeting has been the consideration and adoption of a new constitution, designed to remedy a long-continued evil growing out of the popular character of the Association. The scientific character of the papers and proceedings has very frequently been such as seriously to compromise the standing of the Association in the scientific world. To remedy this, it has been decided to select from the members those who are engaged in science and form them into a separate class of 'Fellows.' All the officers of the Association are now to be chosen from this class, and the power of the several committees to exclude improper or unsuitable communications has been increased. All friends of science will await with interest the working of this improvement. The necessity of some vigorous and effective measures must be obvious to any one who will simply examine the lists of papers presented for reading. Among some hundred authors, the number of really eminent men may be counted on one's fingers, while the large majority are entirely unknown, and present papers which, so far as can be judged from their titles, are of no scientific importance. We greatly doubt whether this evil will be cured by anything short of a radical change in the publishing system of the Association. So long as there is a volume of 'Proceedings' to be published, so long will there be a pressure on the part of the less desirable class of members to have their papers printed, and this pressure can be resisted only by a little more moral courage on the part of the Standing Committee than it has hitherto exhibited. While such papers are admitted, we may be sure that few of the abler members will wish their productions to be seen in such company. It is gratifying to notice that the present meeting exhibits a decided improvement in this respect, and that notwithstanding the general unimportance of the communications, the subjects of ether and atoms do not appear among those discussed before the Association."

UNDER the Principalship of Monsignor Capel, a Catholic College is shortly to be opened in Kensington, in which the Natural Sciences will be taught without restrictions. A museum, a laboratory, and lecture rooms are in readiness; and in the Educational department more than one appointment has already been made. Mr. St. George Mivart is to lecture on zoology during the winter months, and on botany in the summer. Mr. Barff is to lecture on chemistry. From what we hear, it will not be for lack of means that this institution will not be successful.

AMONGST those who will probably be candidates for the professorship of Zoology and Comparative Anatomy, now vacant in University College, London, are Mr. E. Ray Lankester, Dr. J. Murie, and Mr. H. Seeley.

DR. ALLEYNE NICHOLSON has been appointed to the chair of Biology and Physiology about to be established in the Durham University Colleges of Medicine and Physical Science, Newcastle-on-Tyne.

ON the 3rd inst. the Bishop of Exeter laid the foundation-stone of a high-class school, to be conducted under the provisions of the Endowed Schools Act, at Newcastle-under-Lyne. His lordship dwelt chiefly on the advantages of a modern education, embracing chemistry, mineralogy, and mathematics, as compared with the old Latin and Greek system. He congratulated the borough upon doing the most important work that not only the district, but the whole of England could be engaged in, by establishing a school in which boys might not only be taught a little Latin and less Greek, but might be taught modern languages and natural science, so as to fit them for the future occupations of life.

In this connection we would refer to Sir Charles Reed's statement, on Tuesday night, at the Radnor Street Schools, City Road. "With respect to scientific education," he said, "this country is far behind other countries; and in that she has fallen back, as she has also in manufactures and in trade, and is letting such countries as America and Germany run far ahead of her. More attention must be paid in all our schools to the scientific education of children."

THE Duke of Bedford has just sent 100*l*. for aiding in the establishment of the Artisans' Institute for Promoting General and Technical Knowledge, to the Rev. H. Solly, who is to be its first principal. Mr. Samuel Morley, M.P. (who is one of the trustees in conjunction with Lord Lyttelton and Mr. Hodgson Pratt), has also given 100*l*., besides guaranteeing 100*l*. a year for three years. These, with smaller contributions from a number of other friends, have enabled the trustees to take premises in Upper St. Martin's Lane, which will be well adapted for the purpose when considerable alterations have been made in them. The object of the Institute appears to be to exemplify in a central locality, and in a special instance, those plans for the general and technical instruction of the working classes which so many of them now desire to see carried into effect, and which Mr. Solly aimed at promoting on a national scale by the formation of the "Trades Guild of Learning." Pending the satisfactory establishment and full development of the larger organisation, it is hoped that the proposed Artisans' Institute will, both directly and indirectly, give a considerable impulse to the higher as well as technical education of the skilled workmen of the metropolis, as many of their leading men have publicly signified their cordial approval of the project; and the desire for increased culture is rapidly increasing among that important and intelligent class. It is expected that the Institute will be ready to open early in October. Donations in aid of it will be thankfully received, and may be paid to the account of Mr. Hodgson Pratt, treasurer *pro tem.*, at the London and Westminster Bank, 217, Strand.

AN enthusiastic meeting was held in Bombay on the 1st of August, at which a committee was appointed for the purpose of raising a fund by public subscription for a memorial to the late Dr. Bhau Dajee, of whom we gave some account in a recent number.

THE Government of India, says the *Bombay Gazette*, has determined to perpetuate the memory of Dr. Stoliczka, the distinguished naturalist, who met his death on the return journey from Yarkand, by erecting, at the public expense, a tomb over his remains at Leh, and a tablet in the new Indian Museum at Calcutta.

THE death is announced of Sir John Rennie, C.E., F.R.S., the eminent civil engineer, under whose direction some of the most important engineering works of the past half-century have been carried out. Sir John, who died on Thursday last at Bengeo, in Hertfordshire, was born in 1794, and was the son of the late Mr. John Rennie, who designed new London Bridge, and who also designed and executed Southwark and Waterloo Bridges. Mr. Rennie educated his son for his own profession, and left to him the task of executing his designs for London Bridge. On its completion and opening in 1831 Mr. Rennie received the honour of knighthood. Several foreign distinctions had been conferred upon him.

OUR readers will be glad to hear of the safety of the members of the Austrian Payer and Weyprecht Arctic Expedition, who have been out for two years, and who, it was feared, had come to grief. A *Times* telegram, dated Christiania, Sept. 5, gives a brief history of the expedition. They left Tromsö in the *Tegethoff* on the 14th of July, 1872. They encountered compact drift ice in 48° E. long., and worked themselves through until, in 58° E. long., they reached the coast of Novaya Zemlya, under the Admiralty Peninsula. They sailed along the coast to Berch Islands, where they met Count Wiltczek's sloop *Isbjorn*. They sailed together with him further to Barents Islands, near the promontory of Cape Nassau, where they remained at anchor till the 21st of August, 1872, on account of south-westerly storms. There a depôt of provisions was established. They parted with Count Wiltczek and steered north-east the same day, and were completely frozen in. They drifted with the pack ice fourteen months, first north-east to 73° E. long., and then north-west until October 1873. In August 1873 a new land was discovered, They drifted with the ice along this land. They were frozen in. and wintered in 79° 51′ N. lat. and 59° E. long. In March and April 1874 sledge expeditions were sent north and west; 82° N. lat. was passed, and land was seen to the 83rd degree. The extent of the land northwards and westwards was, apparently, considerable. The ship, now being untenable, was abandoned. Starting on the 20th of May, 1874, with four sledge boats, they met the open water on the 15th of August, and crossed to Novaya Zemlya, and went along the coast in search of vessels. They met a Russian schooner on the 24th of August in Puchowa Bay, and arrived at Vardoe, in Norway, on the 3rd of September. The health of the crew was excellent. Engineer Krisch died in March 1874 from tuberculous disease. Large mountain ridges are said to have been observed in the newly discovered land, but no signs of animal life; and immense glaciers were met with.

THE loss is announced of the whaler *Arctic*, of Dundee, at Davis's Straits. The *Arctic* at the time she was lost was full. She was commanded by Capt. Adams, with whom, it will be remembered, Capt. Markham, R.N., of the *Sultan*, made a voyage of investigation a year ago. Capt. Adams had distinguished himself by the surveys which he made of several of the Arctic coasts. All hands have been saved.

THE Berlin African Exploration Society is fitting out a second expedition to the interior of Africa. Herr Alexander von Homeyer, the well-known ornithologist, will be the leader of the expedition, and will go from St. Paul de Loanda by way of Kassimbe to Moatta Jambe.

THE British Bee-keepers' Association, founded in May last, has been fortunate in securing Sir John Lubbock as its President, and though the members number but little over 120, they have already shown a commendable earnestness. On Tuesday they held, at the Crystal Palace, their first show of bees, hives, honey, and accessory apparatus; and during the day some of the bee masters manipulated their hives, showing how to take honey, introduce queens, and to do other necessary work usually supposed to be accompanied with some danger. The primary object of the Association is to promote the more extensive cultivation of bees, especially by cottagers, and the study of the best way of obtaining most honey with the least waste. The American "Slinger" was shown in operation, and effectually drives out by centrifugal force all honey from a comb without injuring the By the application of this principle much of the time that would be occupied in making cells is saved, and bees at once begin refilling the comb. A secondary object of the Association is to promote the study of the habits and powers of bees, and special prizes were offered for observatory hives. Now that Sir John Lubbock has led the way in showing how to observe individual bees (see NATURE, March 26), we may expect that many people will be induced to take up such an interesting subject and add to our stock of knowledge. Almost everything about the powers of bees has yet to be learned. An observatory hive stocked with bees costs, we believe, only about thirty shillings, and the *British Bee Journal* is always willing to give any information to inquirers needing instruction. The last number that has been forwarded to us, and besides giving a great deal of practical instruction, contains an interesting article on the Philosophy of Hive Shape.

The Southport (Lancashire) Aquarium will be opened on the 16th inst.

Among the newly enrolled members of the Victoria Institute is M. Joachim Barrande, the Bohemian palæontologist.

A telegram from Rome of Sept. 5 announces that the eruption of Mount Etna has ceased, but that the shocks of earthquake continue.

The *Melbourne Argus* has the following among its news from the South Sea Islands:—"On the 30th of April Captain M'Kenzie observed what he believed was a submarine volcano in a state of activity. When about midway between Haabai and Tonga, two of the Society Islands, about 12 miles from land, he observed a large column of water shoot up fully 100 feet into the air. There was a dense cloud of what appeared to be steam rising from the ejected water. Captain M'Kenzie was afraid to go sufficiently near to ascertain whether it was warm water that was ejected, but upon this point there can be little doubt. The spot where he saw the water sent up is marked on the chart as a shoal, and so long as he was in sight the water continued to be sent upwards with equal force."

The additions to the Zoological Society's Gardens during the past week include a Toque Monkey (*Macacus pileatus*) from Ceylon, presented by Mrs. Thomas; a Macaque Monkey (*Macacus cynomolgus*) from India; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, presented by Mr. H. C. Marckmann de Lichtabbell; an Arctic Fox (*Canis lagopus*) from the Arctic Circle; a Black-headed Gull (*Larus ridibundus*) European, presented by Mr. Keell; a Prairie Marmot (*Arctomys ludovicianus*) from North America, presented by Mr. Thellusson; a Guilding's Amazon (*Chrysotis guildingi*) from St. Vincent, purchased; four Houbara Bustards (*Houbaria undulata*) from Tripoli, deposited.

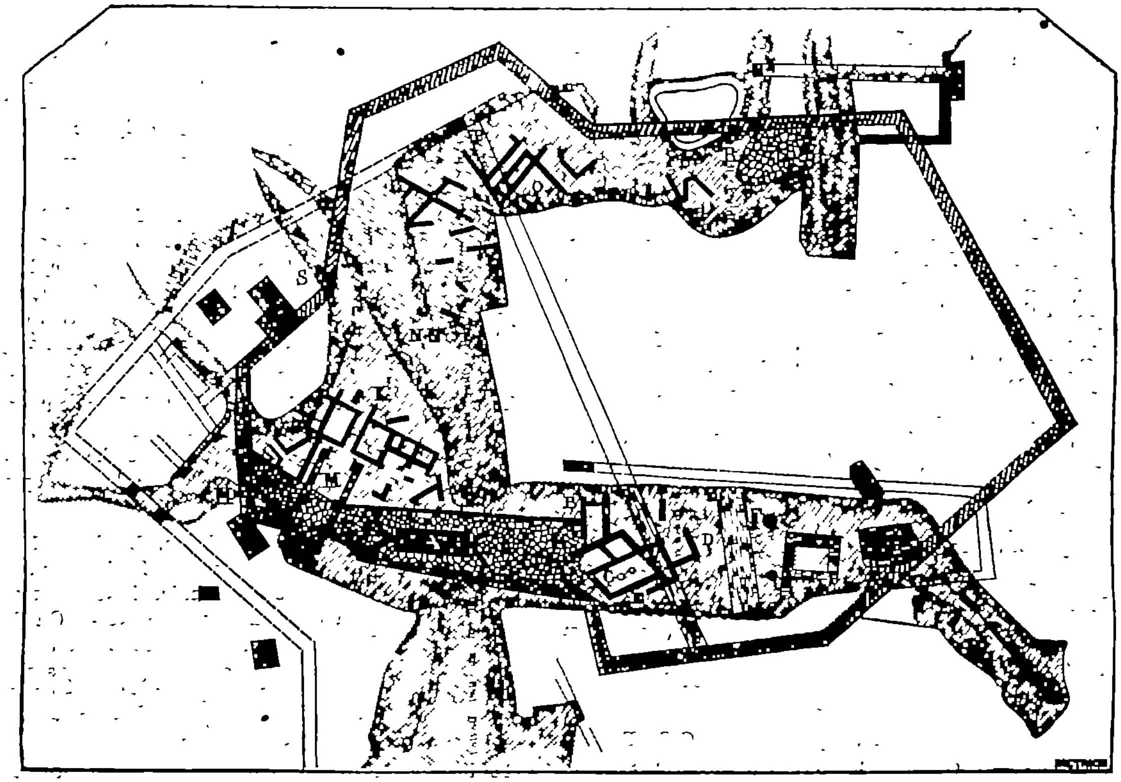


Fig. 1—Plan of Troy in the time of Priam. A. Tower of Ilium. B House of two storeys before the taking of Troy. C. Trojan structures and later structures superposed. D. Trojan houses. E. Large earthenware jars. F. Altar for sacrificing to the Trojan Minerva, with drain for carrying off the blood. G. Remains of Trojan houses. H. Place where the treasure of Priam has been found. K. Remains of Priam's palace. M. Gates. N Wall prior to Troy. O. Trojan houses and later walls superposed. P. Fortified wall prior to Troy. R. Wall of defence prior to Troy. S. Remains of the *enceinte* of Troy.

THE RUINS OF TROY: RECENT DISCOVERIES OF DR. SCHLIEMANN*

OUR age is eminently an age of investigation, and, more than any previous one, is drawn towards archæological studies by a restless and feverish ardour. Dissatisfied with the present, it rushes back into the past, to seek for traces of the most ancient origins of man and of his races, the primitive sketches due to his artistic and industrial genius, the beginnings, still so obscure, of his history, and even of prehistoric times. The learned works of Mr. Layard on Nineveh and Khorsabad, the fruitful excavations of M. Mariette in Egypt, those of the Americans in the mounds and tumuli of the Ohio and Mississippi, the discoveries, so valuable for human palæontology, due to the courageous perseverance of Boucher de Perthes and to the ingenious sagacity of M. Lartet, of Sir Charles Lyell, of Sir John Lubbock, Prof. Wilson, Mr. E. B. Tylor, and others,—does not all this indicate a very distinct movement towards researches which have for their object the vestiges which man has left on the earth or in its depths from the most remote periods?

To the number of the most recent archæological labours which have strongly attracted public attention, we must add, with good reason, the important and magnificent work of Dr. Heinrich Schliemann, which has just been published at Leipzig, under the title of "Trojanische Alterthümer" (Trojan Antiquities).

A poet has said, in speaking of the ancient city, whose misfortunes another poet has sung in immortal verse,—

> "Etiam periere ruinæ."

But Dr. Schliemann and the noble companion of his life and his labours have given the lie to Lucan. Others, it is true, believed that they had discovered the ruins long ago. Towards the end of last century (1788), a French traveller, Le Chevalier, professed even to have proved that Virgil was mistaken in placing, along with all Greek antiquity, the city of Troy and its citadel on the heights indicated by Homer, the little hill which to-day bears the name of Hissarlik.* According to him, the Homeric city must have been built upon the site occupied by the present village of Bunarbashi; the citadel of Pergamos was situated, on the contrary, on one of the rocky hills which encloses the Scamander, and at the summit of which is seen three conical knolls, ranged in a line, which Le Chevalier regarded as the tombs of the Trojan heroes. As to the springs which flow from the foot of the hill, these were, according to the author of the "Voyage en Troade," those where the Trojan girls went to wash their clothes.

---

* Translated from an article in *La Nature*, by Dr. N. Joly, of Toulouse.

Although based on topographic data very open to controversy and upon texts falsely interpreted, the work published in 1788 by Le Chevalier had a very great success (three editions from 1788-1802), and his opinion, thoroughly erroneous as it was, acquired, so to speak, the force of law.

Even quite recently (in 1871), this opinion found an unfortunate defender in Dr. Karl Curtius, of Berlin, and that at the very moment when the excavations of Sir John Lubbock, of Consul Hahn, and, above all, those of Dr. Schliemann, put Bunarbashi out of the question, and brought forward the most convincing proofs in favour of Hissarlik.

In fact, these excavations have demonstrated, as far as evidence can go, that neither the pretended Trojan tombs indicated by Le Chevalier, nor the site of Bunarbashi itself, contains any archaic object, any trace of human habitation. It is, then, neither at Bunarbashi, nor at Chiblak, nor at Atchi-Kienni (which is now quite given up), that we must seek for the veritable Troy and the citadel of Pergamos. Let us see if we shall be more fortunate in carrying on our investigations on the site of Hissarlik; that is to say, in allowing ourselves to be guided by popular tradition, the writings of the most ancient trustworthy authors, and chiefly by the gigantic excavations executed at so great an expense and with so much zeal and intelligence by Dr. Schliemann and his wife.

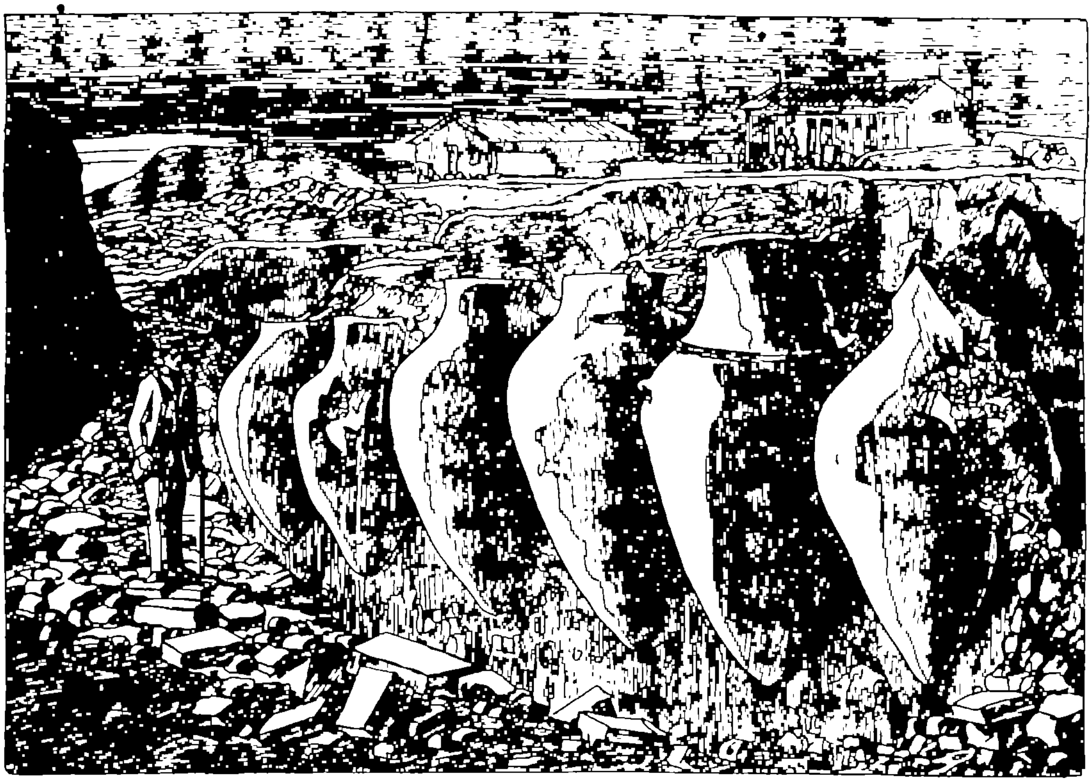


FIG. 2.—Large earthenware jars found in the ruins of Troy, at E, in Fig. 1.

Here, independently of the authority of Homer, we have still that of Herodotus, of Xenophon, of Arrian, of Plutarch, of Justin, who all agree in placing the Ilion of Homer at Hissarlik; that is, at the place where Dr. Schliemann has found ruins overlaid by many layers of more recent ruins. In one of these layers, which extends from seven to ten metres below the summit of the hill, are found, in fact, incontestable proofs of a violent fire,†—a palace, a double gate situated on the west of this palace, a tower rising at some distance from the double gate, religious symbols (images and vases in the shape of an owl, γλαυκῶπις Ἀθηνή), and finally a treasure containing objects which, in their smallest details, answer to the descriptions which Homer gives us. Is there not here enough to satisfy the most sceptical and most exacting?

Begun in the month of April 1870, the excavations executed by Dr. Schliemann were only terminated in October 1873. They have thus occupied him three entire years, and that in the midst of the greatest difficulties, sometimes even at the risk of his life and that of the numerous workmen, Turks and Greeks, whom he employs in these works. I pass in silence the harassing difficulties which the Turkish Government has raised to prevent him attaining the precious results with which these excavations have enriched the science of the past.

(*To be continued.*)

---

* For an excellent study on the topography of Troy, see an article by M. Emile Burnouf in the *Revue des Deux-Mondes*, of Jan 1, 1874.

† M. E. Burnouf places the fire in the seventeenth century B.C., 700 years, according to some, before the time of Homer.

THE BRITISH ASSOCIATION

Reports

Report of the Committee on Experiments to determine the Thermal Conductivities of certain Rocks, by Prof. Herschel and Mr. Lebour.

In the introductory notes on these experiments, published as an appendix (p. 233) in the last volume (for 1873) of the British Association Reports, the list of rocks selected and the manner of experimenting on them were described. With the exception that sections of Calton trap rock, of a great pyramid casing stone (nummulitic limestone), Caen stone (or Normandy building limestone), Cannel coal, chalk, and red brick were added to this list, and that the apparatus received some small but very important improvements to make it heat-tight, the material of the experiments as well as the method of working them remained substantially the same as last year. Instead of a conical tin vessel with 1 lb. of water, a cylindrical one holding 2¼ lbs., with an internal agitator and thermometer, was used as the cooler. The opposite faces of the heater and cooler were lined with velvet and each clasped by a caoutchouc collar, which, projecting a little above them, clips the circular edge of the rock plate when it is placed between them, and two small notches cut in each collar also allow the wires of a thermocouple to be introduced, touching the rock-surfaces while the rock is being heated. With the view of traversing the plate with the thermopile in different directions, the piece of stout palladium wire (about 18 gauge) used as the electromotive element between the two iron wire branches of a delicate reflecting galvanometer, was silver-soldered to the iron wires at its two ends, all the wires being first rolled thin and flat to some distance from the junctions. The scythe or scimitar-blade shape most easily given to the wire in rolling it thin was advantageous in the construction, because, instead of uniting the wires continuously in one straight length and folding the points of junction on opposite sides of the rock (thus confining their range upon it to a single diameter or to one straight line), advantage of the curvature was taken to connect the wires by superposition, instead of by prolongation at their junctions, without overlying each other, into two flat ogee arches, or merry-thought-like blades, between which the rock is held as in a forceps. The straight unrolled parts of the wires are bound very firmly to a square piece of wood, which acts as a handle to guide the points of the forceps to various parts of the rock-faces, while it keeps them securely in their places, and thus allows the small elastic pressure of the wires to clasp the rock gently between the points of the thermo-electric pincette without assistance from the velvet covers. After thus inserting a rock section in the apparatus, protecting the rock and cooler from below with a stout wooden screen, and from loss or gain of heat in other directions by a suitably thick case of woollen stuff and a few bandages of similar materials, the rate of rise of temperature in the cooler, when agitated, was noted by the average number of seconds taken by a delicate thermometer contained in it to rise ½° F. (one graduation on its stem) as soon as this rate of rise was found to have become sensibly constant. About twenty minutes were usually occupied in the beginning of an experiment with waiting for a steady condition of the thermometer readings, and ten or twelve minutes more were required to ensure it and to obtain the average rate of their increase for the rock specimen under observation. The temperature difference shown by the galvanometer at the same time at first rose rapidly to a high maximum and then descended very gradually to a fixed lower reading. The pincette was traversed to and fro over the rock surfaces while the thermometer was being noted, and exhibited during these motions fluctuations answering to about 1° or 2° F. on either side of an average position; corrected for zero of the scale and reduced by trials for this purpose between every two or three experiments to Fahrenheit degrees, the temperature difference thus formed, divided by the quantity of heat transmitted to the cooler per minute, gave the apparent thermal conductivity of the plate. The results in Peclet's units were scarcely more than one-third of what Peclet and other earlier experimenters had obtained. It was obvious that, instead of marking the temperature difference between the two solid contact surfaces of the rock and velvet which they touched, the points of the thermo-electric forceps showed the temperature of the fluid air-bath in which those two surfaces are immersed. The extreme mobility of this integument, enabling it to penetrate through the velvet to the plates of the heater and the cooler, while it equally insinuates itself between the rock surface and the thermopile that can only enter into actual solid contact with each other (at least theoretically) at three points, controls the temperature of the metallic thermometer far more powerfully than the rock face that it touches, and the real temperature differences between the rock faces are accordingly completely masked. It is very probable that if the velvet covers fitted on the instrument were replaced by soft wash-leather, the source of this error would be very much reduced; and although it is certain that the confronting surfaces of the rock and leather faces will nowhere have actually the same temperature, from the existence of a sensible quantity of resisting air between them, so that, as before, the thermopile will not mark the true rock temperature difference, but a mean between that difference and a similar difference for the leather faces, yet the range of this error will be incomparably smaller than in the experiments already made with velvet covers, whose loose texture precludes the possibility of regarding the comparative results now obtained as positively correct, or more than first approximations, from which the errors arising from surface characters of the rock sections tested have not yet been removed.

To obtain the true rock temperature differences, means were taken to cement the thermopile points to the rock with plaster, a course it would be desirable to adopt with as few samples as possible as standards of correction for the rest, on account of the tediousness of the process and the injury that it necessarily entails to the beautifully worked surfaces of many of the plates. If the correction so found to be required can be restricted by the mode of operating to a range of such small limits as to be applicable generally, without appreciable influence of the surface characters, in making its occasional departures from a mean value very sensible, then the reduction factor found by absolute experiments on a few rocks of characteristically rough and smooth or polished surfaces to obtain the true temperature difference for a given heat-flow from the apparent one shown by the thermocouple placed simply between the rock and leather faces will be admissible within the limits of error of the observations to convert a list of apparent conductivities as just supposed to be obtained from a mere comparative table of relative conducting powers to a table of absolute thermal conductivities, in which the errors of the values given will certainly not be greater than would in all probability have been committed had the direct method of absolute measurement been applied separately to each specimen of the list, instead of only to a few rocks, to furnish data on which calculations of the remainder may be founded. Circular discs of linen, well wetted with plaster of Paris, mixed with a little glue or white of egg, were laid over the surfaces of two or three of the rocks, enclosing under them and against the rock (to which they were also plaster-wetted) the two branches of the thermopile pincette. When these had set quite hard under pressure and were thoroughly dried by a gentle heat, they were placed in the apparatus, and a measurement of the absolute temperature difference and accompanying heat-flow was thus obtained, affording the real conductivity and a means of comparing it with the apparent one found by similar observations of the same rock when no plaster was used, and when the points of the thermopile merely pressed against its surface. Thus the thermo-electric difference obtained with the wire couples merely touching the surfaces of white statuary marble between velvet faces was 16°, while for the same heat-flow when the arms of the thermopile were firmly plastered to the marble plate, the temperature difference observed was only 16°·2 *—being more than 2½ times as large a difference in the former as in the latter case. With whinstone the corresponding temperature differences were 26° and 8°·5—in the proportion of very nearly 3 : 1. A similar experiment was made with cannel coal, of which the conductivity is much less than that of the last-mentioned rocks, the temperature differences obtained being for the same heat-flow in the plain and plastered plate 53°·4 and 39°·7; in the proportion of only 1·37 : 1—a far smaller reduction than was observed in the two foregoing cases. Care is, however, necessary to introduce wet plaster under as well as over the points of the thermopile in cementing them to the rock, that air may be excluded and the junction may be solid, a precaution which was omitted in this case, as plaster without size was used, which in drying sometimes flakes off from the rock surface either entirely or in places. This may render an experiment, as that on cannel coal may not impossibly have been, from this cause entirely valueless; yet this result presents itself, with many others met with in the investigation, as very well worth repetition, with fresh precautions and with new arrangements to guard against the possibility of false conclusions.

---

* The heat-flow through the plate was actually greater in this latter than in the former case in the proportion of about 5 : 4—showing that the rough plaster-washed linen surface received and delivered heat to the velvet covers much more readily than the smoothly-dressed surface of the stone, and the whole resistance was less in the latter than in the former case, although the rock plate itself had been made thicker. The same diminution of the total resistance occurred also in the experiment with plastered whinstone.

Adopting for the present, as probably not very far from the truth, a common reduction factor of 2½ as the proportion in which the recorded temperature differences of the plain rock surfaces between velvet faces exceeded the true temperature differences of the surfaces of the rocks examined, and introducing some very small corrections for the thicknesses of the plates, the thermal capacity of the metal cooler, &c., which are all probably (as well as the allowance for heat-absorption in raising the temperature of the rock plates very slowly during the observations) really negligible in comparison with the uncertainty that attaches (except in one or two well-observed cases of absolutely measured temperature differences of the rock faces) to the great majority of the determinations from unknown peculiarities of surface contact and temperature assimilation where air is not excluded from the junctions, or rendered stagnant in its mode of heat transmission, the following table gives the absolute thermal conductivities (in centimetre-gramme-second, or absolute British Association units) thus provisionally obtained, together with a few similar results found by Peclet, Forbes, and Sir William Thomson in rocks differing little in their description from those included in the present list.

Provisional Determinations of Thermal Conductivities of certain Rocks.—First Experimental Results.

Description of Rock.	Thermal conductivity (gramme-water-degree heat units per second) at 1° difference of the faces, through a centimetre cube		Earlier Observations of Conductivities of similar Rocks.	
			Description of Rock	Observers.
Grey Aberdeen granite	·00600			
Red Cornish serpentine	·00483			
Calton trap rock (first specimen)... ...	·00580	·00866	Calton trap rock ... .}	Forbes and Thomson.
Whinstone	·00312	·00169	Sand of experimental rock, Thermometer garden}	
Kenton sandstone	·00489	00689	Craigleith sandstone ... ...}	
Congleton "second grit" stone	·00462			
Slate	·00392			
Alabaster	·00412			
Sicilian white statuary marble	·00559	·0097	Fine-grained grey marble .. ..}	Peclet.
Irish fossil ditto	00559	·0077	Coarse crystalline white ditto .. ..}	
Devonshire red ditto	·00525	·0058	Fine-grained calcareous stone.	
Italian vein marble (white, grey veins)	00512	0047	" " "	
Irish green marble	·00507			
Nummulitic limestone (a piece of Great Pyramid casing-stone)	·00433			
Caen (building) limestone	·00395	0037 ·0035 }	Coarse-grained lias building stone	Peclet.
Chalk	·00384			
Black shale (Newcastle-on-Tyne) ...	·00178			
Cannel coal	·00161			
Plaster of Paris (for castings)	·00163	·00145 00122 }	Ordinary fine plaster (made up) ... ...} Finest ditto for casting (made up) ... ...}	Peclet.

The Report of the Committee for superintending the monthly reports of the progress of Chemistry, by Profs. Roscoe and Williamson, was then read by Prof. Roscoe. The report was very short; the committee does not intend to apply to the British Association for a further grant after the present year.

Report of the Committee on Essential Oils, by W. Chandler Roberts.—The following oils have been examined: Wormwood, Citronella, and Cajeput. The actions of phosphorus pentasulphide, of zinc chloride, and of bromine upon the oils were described. The first-named reagent generally acts by removing the elements of water, with formation of terpenes and cymenes. Zinc chloride generally causes decomposition, giving rise to a mixture of hydrocarbons. Bromine usually forms a bromide, which is then decomposed with evolution of hydrobromic acid and water and formation of a cymene.

Various cymenes have been examined, all of which seemed to be the same. The formation of cymenes from terpenes by the action of sulphuric acid has been verified. Cymenes have also been obtained from oil of turpentine by continued fractionation.

The following numbers express the optical properties of some of these oils:—

	Specific refractive energy.	Specific dispersion.
Absinthol	·4887	·0234
Cajeput	·4916	·0251
Citronella ...	·5213	·0289
Citronellol . ..	·5176	·0284

The conclusion drawn is, that cymene is the central body in these essential oils, to which the other constituents are closely related; the varying amounts of mechanical energy required for the formation of the different isomerides have not as yet been determined.

Dr. Gladstone said that the optical properties of sixteen cymenes had been examined. Some of these were obtained from substances of low, others from substances of high refractive energy, but in all cases the refraction of the cymene was the same; the refraction of a substance depends, therefore, on the constitution of the substance itself.

Report of the Committee on the Estimation of High Temperatures, by J. Dewar, F.R.S.E.—The committee has not carried on any investigations during the past year.

Gold Assays, by W. Chandler Roberts.—Little has been done by the committee during the past year, but they hope to be able to report fully at the next meeting.

Report of the Committee for assisting in the Exploration of the Victoria Cave, Settle, by R. H. Tiddeman, secretary to the committee.

The explorations have been continued throughout the chief part of the year. The Settle Committee have raised by private subscriptions and spent, besides the British Association grant of 50*l.*, a sum of 113*l.* 4*s.* 3*d.* The late determination of a bone which had been found by the committee in the cave in May 1872 as human, by so great an authority as Prof. Busk, induced the committee to pay their chief attention to the question of its position and the relation of the beds in which it occurred to the physical changes to which the district has been from time to time subjected. In order to do this it was necessary to remove a large portion of the tip of the older workings, which had unfortunately accumulated below the entrance of the cave. Beneath this the Romano-Celtic layer was reached, and several objects of bronze, including bracelets, a vinaigrette, and other articles, were obtained. The Romano-Celtic layer was from 1 ft. to 1 ft. 6 in. thick; beneath this was a thickness of 19 ft. of screes, consisting of angular fragments of limestone, which had fallen from the face of the cliff above. This contained no bones whatever, nor the smallest fragment of any rock but the white limestone of which the cliff above is made. But at the base of this a great many boulders were discovered of all dimensions up to 7 ft. in diameter. The number of these boulders and the peculiar conditions of their position render it quite impossible that they can have been brought through any fissure in the roof of the cave, and so washed in later times over the beds containing the human fibula and the remains of the older mammals. The great weight of some of them quite militates against this idea. Another suggestion, that they may not have been left in their present position at the melting of the ice-sheet, but may have fallen from the cliff in comparatively recent times, is also negatived by the complete absence of any evidence of any such fall through the long period represented by the 19 ft. of screes, their occurrence only at the base of the screes, and by the absence of any drift from the cliff above for some distance round. But another strong argument against this supposition lies in the fact that the boulders are so close beneath the cliff, that if all the limestone weathered from the cliff above and now resting on the boulders were restored to the cliff it would project so much further forward that it would be impossible for them to fall into their present position; yet we know from their position that the boulders were dropped there before any portion of the screes had accumulated, and therefore at a time when the roof of the cave undoubtedly reached much further forward.

The inevitable conclusion is that man lived in Yorkshire with *Elephas antiquus*, *Rhinoceros tichorinus*, *Ursus priscus* and *spelæus*, *Hyæna*, *Bison*, and red deer long before the existence of the great ice-sheet in Northern Britain and Ireland.

Report of the Boulder Committee.

The Rev. W. H. Crosskey read the report of this committee appointed for the purpose of recording the position, height above the sea, lithological characters, size, and origin of the more important erratic blocks, and groups of erratic blocks, of England and Wales, and reporting other matters of interest connected with them. A schedule has been issued by the committee containing detailed questions of the information required. The object of the committee is not speculative, but to collect the facts, with the intention of afterwards proceeding to their classification, and pointing out their relations to the various theories under designation in glacial geology. Districts in which boulders are rarest are of special importance. The evidence regarding the southward extension of the ice sheet and the reach of the waters of the glacial sea depends largely upon their presence and absence; while their method of distribution is full of geological meaning. The necessity for the work of the committee is increased by the fact that all over England and Wales the destruction of boulders is rapidly proceeding. In the midland districts, a map is being constructed in which the approximate number of boulders and the character of the rocks of which they are formed, together with the effect of the configuration of the country on their distribution, will be shown. From the general position of the boulders it is evident that boulders were deposited at several ages. There are (1) boulders of the earliest ice periods, (2) boulders of the period of submergence, distributed in the lower parts of the glacial clays, (3) boulders of the period of the re-elevation of the land. There varieties have yet to be traced to their various sources, and upon this work members of the committee are engaged. It is as impossible to assign all the boulders to one epoch of distribution, as it is to relegate all glacial sands, clays, and gravels to one period. The report contains details regarding boulders of various districts. From Leicestershire, one fact of especial importance is recorded. Below the drift clay and quite distinct from the surface boulders freely scattered over the country, a group of boulders has been exposed in an excavation made in the centre of Leicester, 25 ft. deep, composed of rocks of foreign origin, and suggesting a stranded iceberg of an early period. In the same county, isolated boulders of large size, and groups traceable to sources some miles distant, prove Charnwood Forest to have been a centre of ice-action of considerable intensity. In Warwickshire a great change occurs. The drift-beds are reduced almost to pebbles; and local geologists give the name of boulders to specimens which in other parts would not be regarded as worthy of the name. Striations are faint and rare. Their grouping is remarkable, and they come from all points of the compass. Isolated boulders are recorded from Northumberland, Yorkshire, Lancashire, Devonshire, and Denbighshire. The committee request members of the Association who have received schedules to return them, and desire communications from geologists disposed to assist them in their work.

The Close Time Committee.

A report was read from the Close Time Committee with reference to the desirableness of establishing a close time for the preservation of indigenous animals. After stating the steps which had been taken with reference to this subject in Parliament, the committee stated its belief that the effect of birds' nesting on such kinds of birds as are known to be diminishing is altogether inappreciable, while its effect on those whose numbers are not decreasing may be safely disregarded, and consequently that there is no need of any legislative interference with the practice. The committee believed that the only practicable mode of checking the diminution of such birds as have been proved to be decreasing is the effectual protection of the adults from destruction during the breeding season. While the Sea Birds Preservation Act continued to work successfully, the Wild Birds Protection Act had done little, if anything, towards attaining the objects for which it was passed, and in various quarters gave considerable discontent. Birds commonly known as "wild fowl" were subjected to very great persecution through the inadequacy of the present law to protect them; they were rapidly reducing in number; they were not only innocuous, but were of great value as food. Consequently the committee hoped that the efforts they intended to make on behalf of wild fowl in the next session of Parliament would obtain a general support. Representations as to the inordinate slaughter of seals which took place every spring in the North Atlantic Ocean had been made to some members of the committee. There could be no doubt that such slaughter at that season would soon bring these animals to the verge of extermination, as had been the case in many other parts of the world, and since their destruction would affect a very large trade, their proper protection seemed to be a subject not at all unworthy of the consideration of the Government. The committee requested their reappointment.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Perturbations of the Compass produced by the rolling of the Ship, by Sir William Thomson.

The heeling error which has been investigated by Airy and Archibald Smith is the deviation of a compass produced by a "steady heel" (as a constant inclination of the ship round a longitudinal axis, approximately horizontal is called). It depends on a horizontal component of the ship's magnetic force, introduced by the inclination; which compounded with the horizontal component existing when the ship is upright, gives the altered horizontal component when the ship is inclined. Regarding only the error of direction and disregarding the change of the intensity of the directing force, we may define the heeling error as the angle between the directions, for the ship upright and for the ship inclined, of the resultant of the horizontal magnetic forces of earth and ship at the position of the compass. These suppositions would be rigorously realised with the compass supported on a point in the ordinary manner if the bearing point were carried by the ship uniformly in a straight line. They are nearly enough realised in a large ship to render inconsiderable the errors due to want of perfect uniformity of the motion of the bearing point if this point is placed anywhere in the "axis of rolling,"[*] for in a large ship the compass, however placed, is not considerably disturbed by pitching, or by the inequalities of the translatory motion caused by waves.

Hence, supposing the compass placed in the axis of rolling, the perturbation produced in it by the rolling will be solely that due to the variation of the horizontal component of the ship's magnetic force. Such a position of the compass would have one great advantage—that the application of proper magnetic correctors adjusted by trial to do away with the rolling error would perfectly correct the heeling error. To set off against this advantage there are two practical disadvantages: one that the axis of rolling (being always below deck) would not be a convenient position for the ordinary modes of using the compass; the other, far more serious, that in ships, at all events with iron decks, the magnetic disturbance produced by the iron of the ship would probably be so much greater at any point of the axis of rolling than at suitably chosen positions above deck as to more than counterbalance the grand kinetic advantage of the axial position. But careful trials in ships of various classes ought to be made, and it *may* be found that in some cases the compass may with preponderating advantage be placed at the axis of rolling. Hitherto, however, this position for the compass has not been used in ships of any class, and, as we have seen, it is not probable that it can ever be generally adopted for ships of all classes. It is therefore an interesting and important practical problem to determine the perturbations of the compass produced by oscillations or other non-uniform motions of the bearing point.

The general kinetic problem of the compass is to determine the position at any instant of a rigid body, consisting of the needles, framework, and fly card, which for brevity will be called simply the compass, moveable on a bearing point, when this point moves with any given motion. Let the bearing point experience at any instant a given acceleration, a, in any given direction. Let w be the mass (or weight) of the compass, and gw the force of gravity upon it, reckoned in kinetic units. The position of kinetic equilibrium of the compass at that instant is the position in which it would rest under the magnetic forces and a force of *apparent gravity* equal to the resultant of *g w* and a force *a w* in the direction opposite to that of *a*. Now the weight of the compass is so great, and its centre of gravity so low, that the level of the card is scarcely affected sensibly by the greatest magnetic couple experienced by the needles.* Hence, in kinetic equilibrium the plane of the compass card is sensibly perpendicular to the direction of the "apparent gravity" defined above; and the magnetic axis of the needles is the direction of the resultant of the components in this plane of the magnetic forces of earth and ship. Hence it is simply through the *apparent level* at the place in the ship occupied by the compass differing from the true gravitation level that the problem of the kinetic equilibrium position of the compass in a rolling ship differs from the problem of the heeling error referred to above. That we may see the essential peculiarities of our present problem, let there be no magnetic force of the ship herself or cargo. The kinetic equilibrium position of the magnetic axis of the compass will be simply the line of the component of terrestrial magnetic force in the plane of the apparent level. The author then investigates, by a mathematical process, an expression for "the kinetic equilibrium error," which is so named in order to distinguish it from the error actually exhibited by the compass. The kinetic equilibrium error is exactly the error which would be shown by an ideal compass with infinitely short period of vibration. A light quick needle (either with silk fibre suspension or supported on a point in the ordinary way), having a period of not more than about two seconds, shows the rolling error very beautifully, taking at every instant almost exactly the position of kinetic equilibrium. Sir W. Thomson has thus found it so great in a small wooden sailing vessel that it became very difficult to make exact observations with the quick compass, either in the Firth of Clyde or out at sea on the Atlantic, unless when the sea was exceptionally smooth. The kinetic theory of forced oscillations is readily applied to calculate, whether for a wooden or an iron ship, the actual "rolling error" of the compass from the "kinetic equilibrium error," but the author remarks that it would extend the present communication too far to enter on details of this solution. For the present it is enough to say that no admissible degree of viscous resistance can make the rolling error small enough for practical convenience, unless also the period of the compass is longer than that of any considerable rolling to which the ship may be subjected. Probably a period of from fifteen to twenty seconds (such as an ordinary compass has) may be found necessary for general use at sea; and it becomes an important practical question how this is best to be obtained, consistently with the smallness of the compass needles necessary for a thoroughly satisfactory application of the system of magnetic correctors, by which the Astronomer Royal proposed to cause the compass on an iron ship to point correct magnetic courses on all points.

---

[*] One way, probably the best in practice, of finding by observation the position of the axis of rolling is to hang pendulums from points at different levels in the plane through the keel perpendicular to the deck, till one is found which indicates the same degrees of rolling as those found geometrically by observing a graduated scale (or "batten") seen against the horizon.

On the Spectrum of Coggia's Comet, by Dr. Huggins.—The new point noticed in this communication was that the bands of the comet were so far shifted as to indicate—supposing there really was carbon in the comet—that the relative motion of the approach of the comet to the earth was forty-six miles per second. The comet really, however, approached the earth at the rate of twenty-four miles per second; and it was therefore uncertain whether the whole or part of the difference in this velocity was due to the motion of matter within the comet. The brighter portion of the head of the comet was due evidently to a larger proportion of the matter giving a continuous spectrum. It seemed probable, therefore, to the author that the nucleus was solid, heated by the sun and throwing out matter which formed the coma and tail; and part of this was in a gaseous form, giving the spectra of bright lines. The other portion existed probably in small incandescent particles; the polariscope showing that certainly not more than one-fifth of the whole light was reflected solar light.

Further Experiments on Light with circularly ruled plates of glass, by Philip Braham, F.C.S.

Interposing plates of circularly ruled glass in the beam of light from a heliostat, the rings of colour are in the same order by reflection and refraction, the red in both cases being outward.

Observing the rings of reflected colour when the unruled surface of the glass is away from the heliostat, dark bands make their appearance concentric with the coloured rings, if the surface of the rulings is at right angles to the direction of the beam, and on altering the angle of the ruled plate the dark bands expand until they intersect the coloured circles, and also appear considerably beyond them.

Placing a polished plate of speculum metal in contact with the ruled surface of the glass increases the intensity of the dark bands, and by adjustment shows that according to the distance of the reflecting surface from the ruled, the number and thickness of the dark bands are increased or diminished.

A description was given of the heliostat used, the reflector being a rectangular glass prism.

SECTION B—Chemical Science

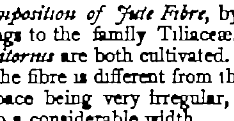
The Chemical Composition of Jute Fibre, by Prof. Hodges.—The jute plant belongs to the family Tiliaceæ. The *Corchorus capsularis* and *C. olitorius* are both cultivated.

The structure of the fibre is different from that of other textile fibres, the central space being very irregular, varying from the thickness of a line to a considerable width.

By the action of aniline sulphate, jute fibre becomes of a golden yellow colour, whereby it is distinguished from hemp and flax. The following is the analysis of jute fibre:—

Wax and fatty matter soluble in ether	0·235
Tannic acid and colouring matter soluble in alcohol	1·135
Sugar, pectine, &c.	2·427
Soluble nitrogenised matters	0·512
Insoluble " "	2·433
Inorganic matter combined with fibre	1·010
Cellular fibre	92·248
	100·000
Nitrogen in original fibre	0·291
Nitrogen in fibre after treatment with solvents ...	0·210

Methyl-thetine, by Prof. Crum Brown and Dr. E. A. Letts.—By the action of bromacetic acid on methyl-sulphide, methyl-thetine hydrobromate is produced. By the action of moist silver oxide on this hydrobromate, silver bromide is found, and by the further cautious addition of the hydrobromate, the silver remaining in solution is removed. By evaporation, crystals of the base methyl-thetine are formed with one molecule of water. This crystallised base might be represented by the structural formula:—



$$\left.\begin{matrix} & S(CH_3)_2 & \\ & | & \\ H- & C & -COO \\ & | & \\ & H & \end{matrix}\right\} + H_2O.$$

By the decomposition of the sulphate of methyl-thetine by means of barium carbonate, the base may also be prepared.

This substance, methyl-thetine, has both a basic and an acid character; with hydrochloric acid it forms a hydrochloride, from which the double platinum chloride has been prepared. A double lead compound containing $2PbBr_2$ has also been prepared.

The action of iodacetic acid on methyl-sulphide does not give rise to the formation of methyl-thetine hydriodate, as might have been expected; but various substances are formed, among which is trimethyl-sulphine iodide.

Experiments on High Pressures, by Dr. Andrews, F.R.S.—The author entered into full details of the methods of preparing and using his well-known tubes for the production of high pressures. If a mixture of nitrogen and carbonic acid be subjected to high pressures (to 290 atmospheres), no trace of liquid is produced.

On the Latent Heat of Liquefied Gases, by J. Dewar, F.R.S.E.—The author has deduced a formula for calculating the latent heat of a gas from the known tension of that gas. The results of this investigation have already been communicated to Section A.

On Spontaneous Generation from a Chemical Point of View, by Dr. Debus, F.R.S.—To the question, "Has Nature ever produced organic substances from strictly inorganic materials?" Chemistry (according to the author) answers, "No!"

On the Estimation of Phosphoric Acid in Pyrophosphate of Magnesia, by Mr. Ogilvie.—The author's experiments lead him to conclude that this process cannot be relied upon unless taken in conjunction with some other, such as the Molybdate process. The influence of a great excess of magnesia, of ammonic oxalate, of citric acid, and of alumina or iron oxide, introduces sources of error.

---

* Generally no adjusting counterpoise for the compass is required when a ship goes from extreme north to extreme south magnetic latitudes.

On an Improved Form of Filter Pump, by W. Jesse Lovett.—This pump, which is very simple and appears to give good results, has already been described in the *Chemical News*.

On Sulphur-Urea, by Prof. Emerson Reynolds.—By heating dry ammonium sulphocyanate, sulphur-urea—as has been before shown by the author—is obtained. If the heat be maintained at 170°, about 26 per cent. of urea is obtained in one hour. By the action of metallic oxides in solution on sulphur-urea, metallic sulphides are obtained, together with cyanamide, which, by the prolonged action of water, is changed into dicyanamide.

On the Joint Action of Carbonic Acid and Cyanogen on Oxide of Iron, and on Metallic Iron, by Lowthian Bell, F.R.S.—The author shows that a mixture of carbonic acid (CO_2) and cyanogen exercises a powerful reducing action at a high temperature upon ferric oxide. With one volume of cyanogen and six volumes of carbonic acid at a temperature of 685° to 710° F., 79·9 per cent. of the oxygen existing in combination with iron was removed, 56·3 per cent. of metallic iron being produced; by increasing the proportion of carbonic acid to fifteen volumes, 6·5 per cent. of metallic iron was produced, while ·9 per cent. only was formed when the carbonic acid amounted to thirty volumes. A certain amount of carbon is simultaneously deposited in the reduced iron. The reducing and carbon depositing power of a mixture of cyanogen and carbonic acid is greater than that of a mixture of carbon monoxide and carbonic acid.

Electrolytic Experiments on Metallic Chlorides, by Dr. Gladstone, F.R.S., and Mr. Tribe.—The authors show that if plates of copper and platinum be immersed in a dilute solution of cupric chloride, a current is obtained from the copper to the platinum, the cupric chloride is broken up into cuprous chloride and chlorine, the former being deposited on the platinum, while the latter combines with some of the copper to form a new cupric chloride $Cu + CuCl_2 = 2\,(CuCl)$. By applying an external current the same action takes place; if, however, the strength of the current be increased, the free chlorine makes its appearance. By substituting zinc for copper a greater effect is obtained; with magnesium in the place of zinc, the effect is still greater. Analogously to the foregoing, a current may be obtained by acting on a solution of mercuric chloride with gold and mercury, whereby mercurous chloride is deposited on the gold.

Composition of certain kinds of Food, by W. J. Cooper.—The author drew attention to the nourishing properties of farinaceous foods, such as arrowroot, corn flour, &c. Such foods he believes very well suited for infants and invalids. He holds that we generally take too much nitrogenous substance in our dietaries.

SECTION C—GEOLOGY

Prof. Harkness, at the request of the Committee of the Section, described briefly the geological features of the North of Ireland. The relations of the Silurian rocks to the Lower Silurians of Sutherlandshire and Cumberland were discussed, and the later formations were noticed in succession.

Prof. H. A. Nicholson exhibited and described a silicified chip of wood from the Rocky Mountains. At the Brighton meeting the same specimen was shown, when the opinion was expressed that its wood-like appearance was due to mineral structure. The chip was then regarded by some members of the Section as a hornblendic mineral, known as "rock-wood." Subsequent examination has shown conclusively that the specimen is undoubtedly true silicified wood. The age of the chip and the circumstances of its production present many points of interest. The author considers it a prehistoric relic, produced by an axe, which was probably formed out of the native copper so frequent in various parts of North America.

Prof. Harkness accepted the views of the author, and withdrew his previous opinion that the specimen was merely a hornblendic mineral.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Mr. Gwyn Jeffreys read a paper *On additions to British Mollusca, and notices of rare species from the deep water off the western coast of Ireland.* As many as forty-seven species of molluscs new to science have been yielded as the results of the dredgings in the *Porcupine*, eighty-four new to the British Isles, and 124 new to Ireland, in addition to a number of other species hitherto considered to exist only in the fossil condition, some of them as low down as the Crag. Dr. Carpenter called attention to the enormous importance of these dredging expeditions, not so much from the number of new species discovered by them as from the light which they seem likely to shed on the question of the continuity of forms of life from one geological age to another. The dredgings off Ushant at a depth of nearly three miles have been especially prolific of results. Dr. Carpenter held out some hopes that the Government might be induced to undertake the expense of a dredging expedition in our own deep seas.

Mr. P. L. Sclater read a paper *On the distribution of the species of Cassowaries*. Until very recently there was supposed to be only one species of *Casuarius*; now at least seven species are known, each with a distinct and very limited area, the genus being entirely confined to Northern Australia, New Guinea, and the adjacent isles. A full exploration of New Guinea would probably lead to the discovery of a large number of most interesting new species.

On the cause of the potato disease and the means of its prevention, by Mr. J. Torbitt. The idea thrown out in the paper was that the disease is owing to the gradual natural decay of particular varieties which never have more than a limited length of life in a thoroughly healthy condition, a view which was combated by most of the gentlemen who took part in the discussion. Mr. Carruthers described the mode in which the spores of the *Peronospora* germinate in enormous numbers on the surface of the potato plant, the germinating filaments, however, only developing to a very limited extent and dying away unless abundantly supplied with moisture. It is only by this means that they are enabled to penetrate into the internal tissues through the stomates. Prof. Du Barry's recent researches seem to point to the possibility that we have in the *Peronospora* an instance of "alternation of generations," one generation only being at present known, the other generation possibly presenting an altogether different appearance, and germinating upon some totally different plant.

Prof. Macalister read *Notes on the specimen of Selache maximus lately caught at Innisboffin.*

Further Researches on Eozoön canadense, by Dr. Carpenter. After an historical account of the controversy respecting this organism, the author proceeded to give additional reasons, the results of recent investigations, for concluding the organic nature of the organism, in opposition to the views entertained by Profs. King and Rowney, of Galway. He took the opportunity of contradicting the assertion made by those gentlemen that Prof. Max Schultze had just before his death stated his conversion to their views. Mr. Gwyn Jeffreys, Prof. Macalister, and Prof. Percival Wright expressed their general concurrence in Dr. Carpenter's views.

SECTION G

MECHANICAL SCIENCE

OPENING ADDRESS BY THE PRESIDENT, PROF. JAMES THOMPSON, LL.D.

For a number of years past it has been customary in this and other sections of the British Association for the Advancement of Science, that the president should give an introductory address at the opening of each new session. In compliance with that usage, I propose now to offer to you a few brief remarks on various subjects of mechanical science and practice. These subjects have not been chosen on any systematic plan. I have not aimed at bringing under review the whole or any large number of the most important subjects at present worthy of special notice in engineering or in mechanics generally. I intend merely to speak of a few matters which have happened to come under my notice, or have engaged my attention, and which appear to me to be interesting through their novelty or through their important progress in recent times, or to merit attention as subjects in which amendment and future progress are to be desired.

In railway engineering, one of the most important topics for consideration, as it appears to me, is that which relates to the abatement of dangers in the conducting of the traffic. The traffic of many of our old railways has become enormously increased in recent years. With the construction of new lines the numbers of junctions, stations, and sidings have been greatly in creased; and each of these entails some attendant dangers. As a natural consequence of the increased traffic on old railways, the additional traffic on new lines, and the increased complexity of the railway system as a whole, there have been during recent years more numerous accidents than in the earlier times of railways. It is to be recollected, however, that with a greater number of people travelling daily, more numerous accidents might be expected, and that their increased frequency, on the whole, does not necessarily indicate increased danger to the individual traveller. Referring to the statistics of railway accidents published by the Board of Trade in Capt. Tyler's Report for the year 1873, I find, for various periods during the last twenty-seven years, throughout the United Kingdom, the proportion of passengers killed from all causes beyond their own control, to the number of passengers carried, to have been, in round numbers:—

Proportion of number killed to number carried in the three years 1847, 1848, and 1849,	1 in 4,782,000
In the four years, 1856, 57, 58, and 59 .	1 in 8,708,000
In the four years, 1866, 67, 68, and 69 .	1 in 12,941,000
In the three years, 1870, 71, and 72 . .	1 in 11,124,000
And in the single year 1873	1 in 11,381,000

It is thus gratifying to observe, that in spite of the increased risks naturally tending to arise through the increased and more crowded traffic and the more complicated connections of lines, the danger to the individual traveller is now less than half what it was 26 years ago; at least this result is indicated, in so far as we can judge, from the statistics of deaths of passengers from causes beyond their own control. That the conducting of the traffic of railways still involves hazards far from inconsiderable, and that we have much to wish for towards abatement of dangers of numerous kinds, is proved by the fact that during the single year 1873 there have been killed of the officers and servants of the railway companies in the United Kingdom, 1 out of every 323: so that, at this rate, extended through a period of, for example, 20 years' service, there would be 1 out of every 16 of the officers and servants killed.

These deaths of officers and servants are not to be supposed to be caused in any large proportion by collisions, and by other accidents to trains in rapid motion. The great majority of them arise in shunting and other operations at stations and along the lines, and occur in numerous ways not beyond the control of the individuals themselves. In respect to the passengers, too, it ought to be known and distinctly recollected, that although collisions and other violent accidents to trains in rapid motion, together with other accidents beyond the control of the individuals, usually cause by far the deepest impression on the public mind; yet the numbers of these fatal accidents are small in comparison with others arising to passengers from causes more or less within their own control. For instance, it may be noticed that in last year, the year 1873, while the deaths of passengers arising from all causes beyond their own control, in the United Kingdom, were only 40 in number, there were four times as many killed, namely 160, in other ways; and of these there were as many as 62 killed in the simple way of their falling between carriages and platforms.

In respect to the conducting of the traffic of the trains in motion, it appears to me, on the whole, that when we consider the vast complexity of the operations involved in working many of our ramified and crowded railways, and when we consider the indefinitely numerous things which must individually be in proper order for their duty, and must be properly worked in due harmony by men far away from one another, some stationed on the land, and others rushing along on the engines or trains, the wonder is, not that we should have numerous accidents, but that accidents should not be of far more frequent occurrence. There can be no doubt, however, but that of the accidents which do occur, many arise from causes of kinds more or less preventible according to the greater or less degree in which due precautions may be adopted.

Gradually, during a period of 20 or 30 years past, a very fine system of watching, signalling, and otherwise arranging for the safety of trains, has been contrived and very generally introduced along our principal lines of railway. In saying this, I allude chiefly to the block system of working railways, with the aid of telegraphic signals and interlocking mechanisms for the working of the points and signals.

In former times it was customary to allow a certain number of minutes to elapse after a train passed any station, or junction, or level crossing, or other point where a servant of the company was stationed, before the succeeding train was allowed to pass the same place. Thus, at numerous points along the line a time interval was preserved between successive trains. It was quite possible, however, that the foremost of the two trains, after passing any of these places where signals were given, might become disabled, or might otherwise be made to go slowly, and that the following train might overtake it, and come into violent collision with it from behind. In order to provide against the occurrence of such accidents, a system was introduced called the *Block System*; and its main principle consists in dividing the line into suitable lengths, each of which is called a *block section*, and allowing no engine or train to enter a block section until the previous engine or train has quitted that portion of the line. In this way a space interval of at least the length of a block section is preserved between the two trains at the moment of the later train's passing each place for signalling, and the risk of this space interval becoming dangerously small by negligence or other accidental circumstances, as the later train approaches the next place for signalling, is almost entirely avoided.

Further, at each signalling station, the various levers or handles for working the points, and those for working the semaphore signals for guiding the engine-drivers, instead of being, as was formerly the case, scattered about in various situations adjacent to the signalling station, and worked often, some by one man and some by another, without sufficient mutual understanding and without due harmony of action, are now usually all brought together into one apartment called the signal cabin. This cabin, like a watch-tower, is usually elevated considerably above the ground, and is formed with ample windows or glass sides, so as to afford good views of the railway to the man who works the levers for the semaphores and points, and who transmits, by electricity, signals to the next cabins on both sides of his own, and, when necessary, to other stations along the line of railway.

The interlocking of the mechanisms for working the points and for working the semaphores which, by the signals they show, control the engine-drivers, consists in having the levers by which the pointsman works these points and signals, so connected that the man in charge cannot, or scarcely can, put one into a position that would endanger a train, without his having previously the necessary danger signal or signals standing so as to warn the engine-driver against approaching too near to the place of danger.

The latest important step in the development and application of the block system is one which has just now been made in Scotland, on the Caledonian Railway. Before explaining its principle, I have first to mention that a semaphore arm raised to the horizontal position is the established danger-signal, or signal or debarring an engine-driver from going past the place where the signal is given. Now, the ordinary practice has been, and still is, to keep the semaphore arm down from that level position, and so to leave the line open for trains to pass, except when the line is blocked by a train or other source of danger on the block section in front of that semaphore, and only to raise the semaphore arm exceptionally as a signal of danger in front. The new change, or improvement, now made on the Caledonian Railway consists mainly in arranging that along a line of railway the semaphore arms are to be regularly and ordinarily kept up in the horizontal position for prohibiting the passage of any train, and that each is only to be put down when an approaching train is, by an electric signal from the cabin behind, announced to the man in charge of that semaphore, as having entered on the block section behind, and when, further, that man has, by an electrical signal sent forward to the next cabin in advance, inquired whether the section in advance of his own cabin is clear, and has received in return an electrical signal meaning "*The line is clear: you may put down your debarring signal, and let the train pass your cabin.*" The main effect of this is, that along a line of railway the signals are to be regularly and ordinarily standing up in the debarring position against allowing any train to pass; but that just as each train approaches, and usually before it has come in sight, they go down almost as if by magic, and so open the way in front of the train, if the line is ascertained to be duly safe in front; and that immediately on the passage of the train they go up again, and by remaining up keep the road closed against any engine or train whose approach has not been duly announced in advance so as to be known at the first and second cabins in front of it, and kept closed, unless the entire block section between those two cabins is known to have been left clear by the last preceding engine or train having quitted it; and is sufficiently presumed not to have met with any other obstruction, by shunting of carriages or waggons, or by accident, or in any other way.

This new arrangement, which appears to be a very important improvement, has already been brought into action with success on several sections of the Caledonian Railway; and it is being extended as rapidly as possible on the lines of the Caledonian Company, where the ordinary mode of working the block system has hitherto been adopted.

The mechanisms and arrangements I have now briefly mentioned are only a portion of the numerous contrivances in use for abatement of danger in railway traffic. It is to be understood that by no mechanisms whatever can perfect immunity from accidents be expected. The mechanisms are liable to break or to go wrong. They must be worked by men, and the men are liable to make mistakes or failures. We shall continue to have accidents; but, if we cannot do away with every danger, that is no reason why we should not abate as many dangers as we can.

Within the past twenty years very remarkable progress has been made in steam navigation generally, and more especially, I would say, in oceanic steam navigation. In this we meet with the realisation of great practical results from the combination of improved mechanical appliances, and of physical processes depending on a more advanced knowledge of thermodynamic science.

The progress in oceanic steam navigation is due mainly to the introduction jointly of the screw propeller, the compound engine, steam jacketing of the cylinders, superheated steam, and the surface-condenser.

The screw propeller, in its original struggle for existence, when it came into competition with its more fully developed rival, the paddle-wheel, met with favouring circumstances in the want then strongly felt of means suitable for giving a small auxiliary steam-power to ships arranged for being chiefly propelled by sails. For the accomplishment of this end the paddle-wheel was ill suited; and so the screw propeller got a good beginning for use on long oceanic voyages. Afterwards, in the course of years, there followed a long series of new inventions and improved designs in the adaptation of the steam-engine for working advantageously with the new propeller; and it has resulted that now, instead of the screw being used as an auxiliary to the sails, the sails are more commonly provided as auxiliaries to the screw. For long oceanic voyages it became very important or essential to get better economy in the consumption of fuel. In order to economise fuel, high-pressure steam, with a high degree of expansion and with condensation, was necessary. This led to the practical adaptation for the propulsion of vessels of the compound engine, an old invention which originated with Hornblower in the latter part of the last century, and was afterwards further developed by Wolff. The high degrees of expansion could not be advantageously used in cylinders heated only by the ordinary supply of steam admitted to them for driving the piston; and more especially when that steam was boiled off directly from water without the introduction of additional heat to it after its evaporation. The knowledge of this, which was derived through important advances made in thermo-dynamic science, led to the introduction into ordinary use in steam navigation of steam-jacketed cylinders, and to the ordinary use also of superheated steam. With increased efforts towards economy of space in the hold of the ship, which became the more essential when very long voyages were to be undertaken, and with the new requirement of greatly increased pressure in the steam, the old marine boilers, with their flues of riveted plates, were superseded by tubular boilers more compact in their dimensions and better adapted for resisting the high pressure of the steam. In connection with these various changes the old difficulty of the growth of stony incrustations in the boilers became aggravated rather than in any way diminished. As the only available remedy for this, there ensued the practical development and the very general introduction of the previously known but scarcely at all used principle of surface condensation instead of condensation by injection. A supply of distilled water from the condenser is thus maintained for feeding the boilers, and incrustations are avoided. The consumption of coal is often found now to be reduced to about 2 lbs. per indicated horse-power per hour, from having been 4 or 5 lbs. in good engines in times previous to about twenty years ago.

Before the times of ocean telegraph cables, very little had been done in deep-sea sounding; but when the laying of ocean cables came first to be contemplated, and when it came afterwards to be realised, the obtaining of numerous soundings became a matter of essential practical importance. In the ordinary practice of deep-sea sounding, as carried on, both before and since the times of ocean telegraph cables, until a year or two ago, a hempen rope or cord was used as the sounding line, and a very heavy sinker, usually weighing from two to four-hundredweight, was required to draw down the hempen line with sufficient speed, because the frictional resistance of the water to that large and rough line moving at any suitable speed was very great. The sinker could not be brought up again from great depths; and arrangements were provided, by means of a kind of trigger apparatus, so that when the bottom was reached the sinker was detached from the line and was left lying lost on the bottom; the line being drawn up without the sinker, but with only a tube, of no great weight, adapted for receiving and carrying away a specimen of the bottom. For the operation of drawing up the hempen line with this tube attached, steam power has been ordinarily used, and practically must be regarded as necessary.

A great improvement has within the last two or three years been devised and practically developed by Sir William Thomson. Instead of using a hempen sounding line, or a cord of any kind, he uses a single steel wire of the kind manufactured as pianoforte wire. He has devised a new machine for letting down into the sea the wire with its sinker, and for bringing both the wire and the sinker up again when the bottom has been reached. With his apparatus, in its earliest arrangement and before it had arrived at its present advanced condition of improvement, he sounded, in June 1872, in the Bay of Biscay, in a depth of 2,700 fathoms, or a little more than three miles, and brought up again his sinker of 30 lbs. weight, after it had touched the bottom; and brought up also an abundant specimen of ooze from the bottom, in a suitably arranged tube attached at the lower end of the sinker.

An important feature in his machine consists in a friction-brake arrangement, by which an exactly adjusted resistance can be applied to the drum or pulley which holds the wire coiled round its circumference, and which, on being allowed to revolve, lets the wire run off it down into the sea. The resistance is adjusted so as to be always less than enough to bear up the weight of the lead or iron sinker, together with the weight of the suspending wire, and more than enough to bear up the weight of the wire alone. Thus it results that the arrival of the sinker at the bottom is indicated very exactly on board the ship by the sudden cessation of the revolving motion of the drum from which the wire was unrolling.

Another novel feature of great importance consists in the introduction of an additional hauling-up drum or pulley arranged to act as an auxiliary to the main drum during the hauling-up process. The auxiliary drum has the wire passed once or twice round its circumference at the time of hauling up, and is turned by men so as to give to the wire extending from it into the sea most of the pull requisite for drawing it up out of the sea, and it passes the wire forward to the main drum, there to be rolled in coils, relieved from the severe pull of the wire and sinker hanging in the water. Thus the main drum is saved from being crushed or crumpled by the excessive inward pressure which would result from two or three thousand coils of very tight wire, if that drum unaided were required to do the whole work of hauling up the wire and sinker.

The wire, though exposed to the sea-water, is preserved against rust by being kept constantly, when out of use, either immersed in or moistened with caustic soda. The fact that steel and iron may be preserved from rust by alkali is well known to chemists, and is considered to result from the effect of the alkali in neutralising the carbonic acid contained in the water, as the carbonic acid appears to be the chief cause of the rusting of steel and iron.

This new method of sounding, depending on the use of pianoforte wire, was first publicly explained by Sir William Thomson in the Mechanical Section of the British Association at the Brighton meeting two years ago; and in the interval which has since elapsed, it has come rapidly into important practical use.

I have to-day already brought under your notice a system of elaborately contrived and extensively practised methods of signalling and otherwise arranging for the safety of trains in motion on railways. These methods, in the aggregate, as we have them at present, may be looked on as the result of a gradual development, which, through design and intelligent selection, has been taking place during the last twenty or thirty years, or more. In contrast with this I have now to mention a reform towards abatement of dangers at sea, which at present is only in an incipient stage of its practical application, but which I am sure must soon grow into one of the important reforms of the future. I refer to the provision of means whereby every important lighthouse shall, as soon as it is descried, not only make known to the navigator that a light is visible, but also that it shall give him the much more important information of what light it is; that, in fact, it shall distinguish itself to him from all other lights either stationed on land or carried by ships out at sea. The rendering of lighthouses each readily distinguishable from every other light, by rapid timed occultations, was urged on public attention by Charles Babbage about twenty or twenty-three years ago, in connection with a like proposal of his for telegraphic signalling by occulting lights. His admirable idea, however, so far as it related to the distinguishing of lighthouses, has unhappily been left almost entirely neglected until quite recently. Although I say it was almost entirely neglected, yet very important steps in the direction of the object proposed were taken many years ago by Messrs. Stevenson, engineers to the Commissioners of Northern Lights, and the flashing and intermittent lights introduced by them, and now used, although too sparingly, in various parts of the world, constituted a very great improvement in respect to distinctiveness. The first practical introduction of an intermittent extinction of a gaslight, which is a method now likely to become fruitful in important applications with further developments, was made many years ago by Mr. Wilson at Troon; and an admirable application of this plan by the Messrs. Stevenson to carry out the principle of rapid signalling is to be seen in the Ardrossan Harbour light, which is alternately visible for two seconds, and then for two seconds is so nearly extinguished as to be invisible. The whole period—four seconds—is, I suppose, the shortest of any lighthouse in the world. This light fulfils the condition of being known to be the light which it is, within five or ten seconds of its being first perceived; and thus, in respect to distinctiveness, I trust that I may without mistake say it is the best light in the world. Mr. John Wigham has succeeded in constructing large burners for the combustion of gas in lighthouses in general, including those of the first order, and embracing both fixed lights and revolving lights. He has also, in both these cases, applied with the most striking success the principle of occultation. Dr. Tyndall, in his reports to the Board of Trade, has dwelt frequently and emphatically on the ease with which gas lends itself to the individualisation of lights. By its application, he affirms that by simple arrangements it would be possible to make every lighthouse declare its own name. Within about the last two or three years the subject has been taken up energetically by Sir William Thomson. He has become strongly impressed with the enormous importance of the object in question. He has perseveringly laboured in making trials in various ways, both by the method of partially extinguishing gas flames and by the method of revolving screens; and I have pleasure in stating that, as a result of his efforts, a self-signalling apparatus is now constructed for the Belfast Harbour Commissioners, who are preparing to bring it into immediate use at the screw-pile lighthouse at the entrance of the harbour of Belfast. I shall not now enter on any description of this arrangement, as I understand that the apparatus, which has already been temporarily erected for trial in the lighthouse, and has shown good results, is to be exhibited and explained to this Section by Mr. Bottomley, who, as a member of the Board of Harbour Commissioners, has taken an active part in the promotion of the undertaking.

I wish next to make mention of the very remarkable works at present in progress in the harbour of Dublin, under the designs and under the charge of Mr. Bindon Stoney. In order to form quay walls with their foundations necessarily deep under water, he constructs on land gigantic blocks of artificial stone, or, as we may say, of concrete masonry, each of which is about 350 tons in weight, and which are accurately formed to a required shape. After the solidification of the concrete, he carries them away and deposits them on an accurately levelled bottom of sea, so that they fit closely together, and form so much of the quay wall in height as to reach above the low tide level; and so as to allow of the completion of the wall above by building in the usual manner by tidal work, and to allow of the whole structure being carried out without the use of coffer-dams. These operations are on a scale of magnitude far surpassing anything done before in the construction and moving of artificial stone blocks. They are carried out with machinery and other appliances for the removal and the placing of the blocks, and for other requirements of the undertaking, which are remarkable for boldness of conception and ingenuity of contrivance. The new methods of construction devised and applied in these works by Mr. Stoney are recognised as being admirably suited for the local circumstances of the site of the works in the harbour of Dublin, and their various arrangements form a very important extension of the methods of construction available to engineers for river and harbour works.

While progress has been made with gigantic strides in many directions, in engineering and in mechanics generally; while railways, steamboats, and electric telegraphs have extended their wonders to the most distant parts of the world; and while trade, with these aids, is bringing to our shores the produce even of the most distant places, to add to our comforts and our luxuries; yet, when we come to look to our homes, to the places where most of our population have to spend nearly the whole of their lives, I think we must find, with regret, that, in matters pertaining to the salubrity and general amenities of our towns and houses, as places for residence, due progress in improvement has not been made. Our house drainage arrangements are habitually disgracefully bad; and this I proclaim emphatically, alike in reference to the houses of the rich and the poor. We have got, since the early part of the present century, the benefit of the light of gas in our apartments; but we allow the pernicious products of combustion to gather in large quantities in the air we have to breathe; and in winter evenings we live with our heads in heated and vitiated air, while our feet are ventilated with a current of fresh, cold air, gliding along the floor towards the fireplace to be drawn uselessly up the chimney. A very few people have commenced to provide chimneys or flues to carry away the fumes of their more important gaslights, in like manner as we have chimneys for our ordinary fires. In mentioning this, however, as a suggestion of the course in which improvement ought to advance, I feel bound to offer a few words of caution against the introduction of flue pipes for the gas flames rashly, in such ways as to bring danger of their setting fire to the house. People have a strong tendency to require that such things as these should be concealed from view. In this case, however, special care should be taken against rashly placing them among the woodwork between the ceiling of the apartment and the floor of the room above or otherwise placing them in unsafe proximity to combustible materials. In many cases it would be better to place the flue exposed to view underneath the ceiling, and by introducing some accompanying ornamentation, to let the flue be regarded as a beneficent object not unpleasing to the eye.

The atmosphere of our large towns, where people live by hundreds of thousands all the year round, is not yet guarded against needless pollution by smoke, jealously, as it ought to be. Many of the wealthier inhabitants take refuge in living in the country, or in the suburbs of the town, as far away as they can from the most densely built and most smoky districts; but the great masses of the people, including many of all ranks, must live near their work, and for them at least greater exertions are due than have yet been made towards maintaining and improving the salubrity and the amenities of our towns. As to the abatement or prevention of smoke from the furnaces of steam-engines, the main requisites have long been very well known; but sufficient energy and determination have not yet been manifested towards securing their due application in practice. In too many cases futile plans have been tried, and on being soon abandoned have left a strong impression against the trying of more experiments; and this may account in part for the introduction of real improvements having been so slow

Smoke occurs when fresh coal is thrown suddenly, in too large quantity at once, upon a hot fire. By extreme care a fireman may throw coal into his furnace so gradually as to make very little smoke; but mechanical arrangements for introducing constantly and uniformly the new supply of fresh coal have been devised, and several of these have been such as to reduce the smoke emitted to almost nothing. I have seen in the neighbourhood of Glasgow, at a large manufacturing establishment at Thornliebank, one method which is applied to about thirty ordinary 40-horse-power boilers, in which upwards of 100 tons of coal are daily burned, and from the chimneys of which not more smoke is emitted than from many a kitchen fire. This method is under the patent of Messrs. Vicars, of Liverpool, and it seems to work very well. It has been about two years in work there. It was introduced at a time when coal was exceedingly high in price, an much to effect economy in fuel as to prevent smoke; and although the first cost was somewhere about 130*l.* per boiler, the proprietor considers himself to be already more than recouped for his outlay, as a saving of fully 12 per cent. in the fuel consumed was effected. At the same works I have also seen in operation the method of Messrs. Haworth and Horsfall, of Todmorden, which has, I am told, in certain circumstances, some advantages over the other. In this, as in the other, the coal is fed in uniformly by mechanical arrangements. The mechanism is different in the two cases, but the result in the motion communicated to the coal is very much alike in both. The bed of coal, which is gradually supplied in front, is caused to travel along the bars towards the inner end of the furnace, and the combustion proceeds in a very uniform manner in conditions highly favourable to economy of fuel, and without the emission of almost any visible smoke.

These two methods I have mentioned because they appear both to work very successfully in practice, while they both bring into effect the principle of action of the fuel which has long appeared to me to be the best that can be adopted for ordinary cases of steam-engine boilers.

I have now occupied, I think, enough of your time, and so I will conclude. I have endeavoured to select out of the wide range of subjects which fall within the scope of the Mechanical Section of the British Association, a few which have come more particularly under my own notice, and on which I thought it was in my power to give intelligence that might be interesting as to past progress, and suggestions that might be useful towards extension of improvements in the future.

SCIENTIFIC SERIALS

Archives des Sciences Physiques et Naturelles, No. 198.—M. C. Marignac contributes a paper On the simultaneous diffusion of certain salts, and gives long tables of the results of his experiments.—M. Marc Micheli gives a note of eighteen pages in length, On the Onagraceæ of Brazil, of which the greater part is taken up with the genus Jussiæa. He sums up the distribution thus:—

		N. America	Mexico.	Antilles.	Guyane.	Pacific States.	Brazil.
Eujussiæa	23	1	2	5	7	7	22
Oligospermum	12	2	3	4	5	4	10
Macrocarpon	4	1	2	2	2	2	4
		4	7	11	14	13	36

—M. Maurice de Tribolet gives a concise history of the study of the genus Nerinæa, and gives analytical tables showing the distribution of species in the Jurassic beds of the Jura. The meteorological observations made at Geneva, under Prof. Plantamour, during May, conclude the number.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Aug. 31.—M. Faye in the chair.—The following papers were read:—Astronomy at the Italian Spectroscopic Society, by M. Faye. This was a reply to some criticisms of P. Secchi. The author pointed out that P. Secchi's theory of sunspots was a return to the idea announced by Galileo in 1612, the clouds being buried in the body of the sun instead of floating above it. The theory advanced by the author on the other hand had been pronounced by Mr. Langley to be a *vera causa*. This *vera causa*, according to M. Faye, is nothing more than a law of hydrodynamics, perfectly established for terrestrial air and water currents.—Remarks on the fish of the Algerian Sahara, by M. P. Gervais. The remarks refer to species of *Coptodon* and *Cyprinodon*, the former of which had been cited by M. Cosson as proving the continuity of the sheet of water which extended over this region.—Note on the development of the contractile coat of the vessels, an anatomical paper by M. C. Rouget. New researches undertaken by the author on amphibian larvæ establish beyond doubt the contractibility of the ramified protoplasmic cells observed last year in the vessels of the hyaloid membrane of the adult frog.—On winged *Phylloxera* and its progeniture, by M. Balbiani. The author points out the complete analogy between *Phylloxera vastatrix* and the *Phylloxera* of the oak.—New observations on the migrations of *Phylloxera* to the surface of the soil and on the effects of the method of submersion, a letter from M. G. Bazille to M. Dumas. The letter contained a note, published in the *Messager du Midi*.—M. P. Mouillefert addressed also a letter containing observations on the employment of the chief insecticides from experiments tried in the laboratory at Cognac and on the vines of the neighbourhood.—M. P. Rohart addressed a letter on the action exercised by the soil on insecticide gases.—Other communications relating to *Phylloxera* were received from MM. Delfan, A. Richard, Gauthier, L. Rousseau, &c.—On a physiological phenomenon produced by excess of imagination, a letter from M. P. Volpicelli to M. Chevreul. Two experiments were made with magnets upon nervous subjects, to see if the effects produced were really magnetic or due to the imagination. In the first experiment a piece of unmagnetised iron was shown to the patient, who immediately fell into convulsions. In the next experiment a magnet was placed in the hand of a nervous subject, who at the end of a few seconds became so over-excited that the magnet was removed. That the effect thus produced was due to the sight of the magnet was proved by hiding several powerful magnets in the chair occupied by the same individual, who when thus unconscious of their presence experienced no ill effect. M. Chevreul made some remarks *à propos* of the foregoing paper on certain other illusions, such as the divining pendulum and divining ring.—Remarks on recent researches concerning the explosion of powder, by MM. Roux and Sarrau. The authors pointed out the agreement between certain of the results obtained by them and by MM. Noble and Abel in their recent communications to the Academy.—New note on the tail of Coggia's Comet, by M. A. Barthélemy. The theory of a repulsive force emanating from the sun requires, according to the author, that the axis of the tail should always be a prolongation of the radius vector. With Coggia's Comet, however, as observed by M. Heiss on July 5, the tail made an angle of 160° with the radius vector. The facts appear to the author to be simply explicable by the hypothesis of an interplanetary medium submitted to the attractive action of the sun, through which medium the comet travels with an increasing velocity; fans and jets are supposed to be the result of the sun's attraction on the denser portions of the cometary matter.—On a new theory of the formation of comets and their tails, by M. Virlet d'Aoust. In 1835 the author suggested the hypothesis that comets were nascent stars—the internal and still incandescent portions shining through cracks in the dark surface. This view was afterwards abandoned for Saigey's hypothesis, which considered the tails of comets as the result of the reflection of their light on an atmosphere which they drew after them. This opinion was again modified to meet the researches of Weiss, Schiaparelli, Klinkerfues, and Oppolzer, who showed the connection between the comets of 1862 and 1866, of Biela and Pogson, and the annular meteor streams which give us the August and November shooting stars. The author then asked whether comets did not equally belong to rings which had given rise to their existence, and if the light emitted by their tails did not simply result from the reflection of light from the nucleus on to the cosmical particles which constituted the rings on which they seemed to depend. The recent researches upon Coggia's Comet confirm this view in the author's opinion.—On a new model of prism for direct vision spectroscopes, by M. J. G. Hofmann.—On some points in the anatomy of the common mussel (*Mytilus edulis*), by M. Ad. Sabatier.

CONTENTS

PAGE
THE INTERNATIONAL CONGRESS OF ORIENTALISTS 375
ANDERS JONAS ANGSTROM 376
THE IRON AND STEEL INSTITUTE 377
SHARPE'S "BIRDS IN THE BRITISH MUSEUM" 378
OUR BOOK SHELF 380
LETTERS TO THE EDITOR:—
  A Remarkable Thunderstorm.—C. WAKEFIELD 380
  The Exhibition of Specimens and Apparatus at the British Association.—ALFRED W. BENNETT, F.L.S. 380
  Photographic Irradiation.—W. J. STILLMAN 381
  Pfluger on the "Salivary Glands" of the Cockroach.—Dr. W. AINSLIE HOLLIS 381
CONFERENCE FOR MARITIME METEOROLOGY 381
ON SEWAGE AND SEWAGE FARMING. By Prof. THOMAS BALDWIN . . 381
NOTES 382
THE RUINS OF TROY: RECENT DISCOVERIES OF DR. SCHLIEMANN (*With Illustrations*) 384
THE BRITISH ASSOCIATION 386
SCIENTIFIC SERIALS 394
SOCIETIES AND ACADEMIES 394

THURSDAY, SEPTEMBER 17, 1874

THE EDUCATION OF WOMEN

NONE of the subjects discussed at the recent meeting of the British Association at Belfast were of greater practical importance than the one introduced to the notice of the Economic Section by Mrs. Grey in her paper on the Science of Education, and supplemented by the address afterwards delivered by her at a meeting held under the auspices of the National Union for Improving the Education of Women of all Classes. So much nonsense is talked and written on the theme of the higher education of women, the utterances even of some of those who are looked on as authorities on the question are too often so doctrinaire and unpractical on one side or the other, that it is a relief to read the well-considered and thoughtful reflections of one who has bestowed much labour and serious thought upon it, and who has given evidence that she is wedded to no preconceived views. The crowded attendance at the Section when Mrs. Grey's paper and the two which followed it—also by ladies—were read, and the lengthened and animated discussion to which they gave rise, sufficiently evince the wide interest felt in the subject by those who attended the meetings of the Association.

The branch which specially concerns us is the extent to which instruction in some or all of the various branches of science should enter into the liberal education of women; and this again is but a phase of the more general question as to the mode in which, if at all, the education of girls should differ from that of boys. We may set aside on the present occasion as a subject of too great importance to be discussed in a general article like this, the much-vexed question of the Medical Education of Women. With regard to the difference which has been established by general custom or prejudice between the ordinary curriculum of the studies of boys and girls, Miss Davies has pointed out with great force, in one of her Essays on the Higher Education of Women, what appear at first sight some glaring inconsistencies and absurdities. To boys who are destined for a mercantile life or a public career, an intimate acquaintance with French and German is now almost indispensable; Latin and Greek are therefore almost universally taught in boys' schools, while the modern languages are considered an essential part of the course of study of a girl, to whom they will be of much less service. A fair knowledge of the elements of physics and chemistry would be of immense advantage to a woman in the management of a household; but these are subjects considered by many to be decidedly unfeminine. Music is the most inexhaustible and harmless recreation for the mind overtasked with the burden of daily cares; but music hardly comes within the scope of a boy's education, at least in this country; while it is almost compulsory on girls, whether they have the talent for it or not, and who have at all events abundant other occupation, such as needle-work, for their leisure moments. The earliest years of a child's life are almost entirely regulated, for good or for evil, by the mother and her female dependents; but any knowledge of human physiology or hygiene has been till recently almost forbidden to the girl on the score of delicacy. May we not sum up by saying that few men have the leisure, after they arrive at manhood, for pursuing the studies of their youth; while an enormous number of women of the upper and middle classes would be most thankful for a rational substitute for the purposeless vacuity in which they are at present forced to spend a large portion of their time? And yet in the face of this it is still the orthodox creed that the education which any English gentleman gets or can get at a public school or University is too broad or too deep for the mass of women of the same class.

An almost ludicrous instance of the difficulty which is experienced practically in the attempt to frame a curriculum of studies which shall be specially adapted for girls, was brought out in the recent debate in the Convocation of the University of London on the desirableness of admitting women to degrees. When the existing General Examination for women was instituted, a Committee of the Senate was appointed to draw up a scheme which should meet all the requirements of the case. After long deliberation, the extent to which it was found possible to deviate from the ordinatry Matriculation examination was this: Greek was made optional; and girls were allowed to take Botany if they wished instead of Chemistry, and Italian if they preferred it instead of German; they were also exempted from all the books of Euclid except the first, if they took Geography instead! The first of these indulgences is now extended to boys; and the other differences are so trivial that we are glad to see that another Committee of the Senate has already recommended that the examination be altogether assimilated to that for Matriculation. When this is done, it may possibly occur to the Senate that there will be no object in keeping up a distinction of name between the two; and how will it then be possible to refuse to women examinations which shall be equivalent to those that admit men to degrees, at least in the Faculties of Arts, Science, and Laws? We do not propose here to discuss the expediency of nominally permitting women to take degrees in our universities; but there is one aspect of the question which has hardly been sufficiently considered by those who oppose the innovation. A university degree is the acknowledged hall-mark of a certain standard of education for men who make teaching their profession. A very large number of women are equally dependent on teaching as a means of livelihood; notwithstanding the many additional facilities given them of late years for acquiring knowledge, they have at present no equivalent test of their qualifications; and as long as this is the case the really competent governess or schoolmistress will always be subject to unequal competition from her incompetent sisters, and the rising generation of both boys and girls will be the sufferers.

The vision that frightens many from looking with candid and impartial mind at the problem of the *higher* education of women is the fear that the educated woman will be lifted out of what we are pleased to term her sphere, and rendered unfit for what man considers to be her duties. But the admirers of the uneducated woman may take comfort in the assurance given them by Prof. Fawcett at the Brighton meeting of the British Association, that whatever facilities are offered for improving their minds, there will still be left for many years an ample supply of those who prefer to remain ignorant and uncultured to satisfy all demands. In the noble address delivered by Prof. Huxley at Belfast, he insisted, with all the force of his calm eloquence, on the folly of making a bugbear of logical consequences; and in no science is there more need for this exhortation than in that of education. Mrs. Grey well put it that no education is worthy of the name that does not at least aim at a right training of the three departments of the mind—the reasoning faculties to determine the right from the wrong, the emotional to follow the right when found, and the imaginative to conceive the perfect ideal of all goodness. In determining a course of education, whether for boys or girls, when we have once satisfied ourselves that our principles are sound, let us unhesitatingly follow them out, letting the possible consequences take care of themselves; and we may feel sure that the conclusions to which we shall be led will stand the test of experience.

The point which we think should be most prominently brought forward by the advocates of a reform in female education is not so much the desirableness of turning its future current in any one direction, as the necessity for removing all trammels and barriers raised by man's ignorance or prejudice. On this ground we sympathise most heartily in all the efforts now being made to widen the basis of the education of women, whether in the way of special colleges, university examinations, or courses of lectures involving severe study. Let us first of all—divesting ourselves of all preconceived theories on the subject, whether social, metaphysical, or physiological—give free scope to the faculties of woman before we begin to dogmatise on the extent to which these faculties will bear cultivation. Natural Selection will point out the occupations in which the female mind will excel; and the Survival of the Fittest will determine the professions in which woman can successfully compete with man. And every one who believes that faculties were originally endowed or gradually evolved for the purpose of being used, and powers for the sake of being exercised, must rejoice at every fresh extension of the field in which they may be employed.

DE BOISBAUDRAN ON SPECTRES LUMINEUX

Spectres Prismatiques et en Longueurs d'Ondes destinés aux Recherches de Chimie Minérale. Par M. Lecoq de Boisbaudran, avec Atlas des Spectres. (Paris: Gauthier-Villars, 1874).

THE spectrum maps of Kirchhoff, Huggins, Angström, and Thalen are so complete that little has been left for later observers except the filling up of some details. Angstrom's discovery that the bright lines which form the spectrum of the electric spark are partly due to the air or other gaseous medium traversed by the spark, partly to the vapour of the metallic poles, formed an epoch in the history of spectrum analysis; and the publication of the fine map of the solar spectrum by Kirchhoff (founded on the great original work of Fraunhofer), in which the positions of a large number of the metallic lines are carefully laid down, gave a great impulse to the pursuit of this branch of physical science. For the discovery of the new metals, cæsium, rubidium, thallium, and indium, we are indebted to spectroscopic analysis. In a paper communicated to the Royal Society in 1863, Mr. Huggins gave a valuable map of the bright lines of the metals, as seen through a system of prisms adjusted for a minimum deviation of the line D of Fraunhofer. This was followed by the works of Thalen and Mascart, in which the positions of the metal lines are given in wave-lengths. The results obtained by Thalen are incorporated in the great work of Angström on the solar spectrum.

To observe the metal lines, the method usually employed is to pass the spark from a Ruhmkorff's machine, having a condenser connected with the fine wire, between poles of different metals. The air lines which come into view at the same time are easily distinguished by well-known characters from the metal lines, and were used by Mr. Huggins to fix the positions of the latter. In some cases the metal lines were obtained by drawing sparks from solutions of the chlorides.

In the work of M. Lecoq de Boisbaudran, two methods are chiefly followed for obtaining the spectra of the elements and of certain compound bodies. The first is the ordinary method of heating the body in the flame of a Bunsen burner; the second is to pass short electrical sparks from a Ruhmkorff's coil, *without condenser*, between a solution of the chloride of the metal and a fine platinum wire suspended above the solution. In the latter case the following is the method of experimenting usually employed by him:—The metallic solution is contained in a short glass tube, into the lower end of which a platinum wire is hermetically sealed. Another wire of platinum, or, still better, of iridium, attached to an insulating support, is adjusted at a distance of two or three millimetres from the surface of the liquid. An essential condition to the success of the experiment is to make the free wire positive, and the liquid negative. If this condition is reversed, the spectrum of the solution seldom appears, but is replaced by the ordinary air spectrum. In some cases, as with the alkaline salts, a fine spectrum is obtained by passing sparks between a fused bead of the salt and a platinum wire heated to redness in a Bunsen or spirit flame. According to M. Lecoq de Boisbaudran, the spectrum produced in this way is not only more brilliant, but is richer in metallic lines than that of the solution. The method of taking sparks in air between metallic poles has been employed in the work before us only in the cases of aluminium and lead. The spectroscope employed was formed of a single prism of heavy glass, with a collimator, and telescope moveable on a graduated arc. An illuminated scale, projected from the anterior surface of the prism, was seen above the spectrum, and its indications were reduced to wave-lengths by comparison with the wave-lengths of certain solar and metallic lines, as determined by Fraunhofer, Mascart, Angström, and Thalen.

In a series of twenty-eight finely-executed engravings, M. Lecoq de Boisbaudran has given delineations of the spectra of a large number of bodies referred to the arbitrary scale of his spectroscope, and also in wave-lengths. Except in a few cases, he has not attempted to represent the feebly illuminated ground or continuous spectrum which in many instances extends over nearly the whole field of view. But the characters of the bright lines and bands are carefully represented, and a full description of them is given in the body of the work. The whole is designed to facilitate the application of spectrum analysis to mineral chemistry; and although some of the details may hereafter require correction, the work is well executed, and cannot fail to be of great value to the scientific and practical chemist. The frequent reproduction of the comparatively simple spectra of the metals obtained at the low temperature of the gas flame in elementary works of chemistry, unaccompanied by sufficient explanation, has tended to give rise to partial and even incorrect conceptions of the grandeur and extent of this subject. How many persons believe that the spectrum of sodium consists solely of a pair of fine lines corresponding to the double line *D* of the solar spectrum? How few know that at the high temperature of the electrical spark it exhibits three other pairs of well-defined lines, one in the orange, another in the yellow, and another in the green, together with a nebulous band on the confines of the blue? (Huggins). All these lines may easily be seen by passing the electrical spark in a non-luminous flame between a fused bead of sulphate or chloride of sodium and a platinum wire, together with a few other feeble lines, especially in the violet (Lecoq de Boisbaudran). The vivid line in the red, with its faint companion in the orange, which forms the ordinary spectrum of the compounds of lithium in the gas flame, gives place to a very different spectrum, when sparks are drawn from a solution of the lithium salts. The red ray still continues vivid, but it is surpassed in intensity by the orange, which is now the most characteristic of the lithium rays, while two new rays or lines come into view (λ 497·0, 460·4). With a solution either of the ferrous or ferric chloride, the electrical spark gives the numerous lines with great sharpness and accuracy of detail, which constitute the spectrum of metallic iron.

M. Lecoq de Boisbaudran gives a delineation of what he considers to be the spectrum of oxide of barium, as it appears after a prolonged heating of the chloride in the gas flame, and also of the spectra proper of the chloride, bromide, and iodide of barium, as obtained by heating those salts in the gas flame charged with hydrochloric acid, bromine, and iodine vapours respectively. These spectra are all different. Thus, in the case of the chloride, only slight traces of the lines and bands due to the oxide are seen, while six new lines appear which are very intense (A. Mitscherlich). On the interesting subject of the bright lines which compose the spectrum of the earth erbia and its phosphate, the following observations are made in the work before us.—"According to Bunsen and Bahr, the addition of a little phosphoric acid to solid erbia gives to that earth a greater emissive power and renders the lines sharper, without modifying their number or position. On repeating this experiment, I find that erbia alone and erbia to which phosphoric acid has been added give very different spectra. On comparing the spectra, the red is more developed in the light of the phosphate, whilst the green and the violet-blue are more vivid in that of the oxide."

The limits of this notice do not permit the discussion of questions of great interest in spectrum analysis, many of which promise soon to be fully resolved. The observation of Roscoe and Upton, that the broad bands characteristic of certain metallic compounds at the low temperature of the gas flame disappear at the higher temperature of the electrical discharge, and the view they have set forth, that in the former case the spectrum is that of the compound, in the latter case that of the metal, have received confirmation from later researches. Lockyer, in his valuable contributions to spectrum analysis, has shown that what he designates the shortest lines disappear first on reducing the pressure, and that the difference between the spectrum of the chloride and the spectrum of the metal is that under the same spark condition all the short lines are obliterated in the former case. The same investigator has observed that metallic elements of low specific gravity, such as sodium, calcium, magnesium, and aluminium widen their lines by increase of vapour density, while metallic elements of high specific gravity, such as iron, cobalt, and nickel, increase under the same condition the number of their lines.

THOMAS ANDREWS

OUR BOOK SHELF

Comets and the New Comet of 1874. By the Author of "Astronomy Simplified for General Reading." (London: William Tegg and Co., 1874.)

THIS book purposes to be "a complete popular account of all that is known of these wonderful bodies which are so great a perplexity to science:" but the work consists of only 56 pages, and it is needless to say that even a popular account of these bodies to be complete must extend over a much larger space. We think that a work on any subject in science, to be popular, that is written to be read by the public at large and not by persons who are conversant with the subject only, should not refer to explanations or theories that are not generally known, without a very intelligible explanation; theories of the action of observed phenomena should not be given without a very strong probability of their truth, or without a caution against their acceptance; and in dealing with a subject like the present one, when our knowledge is limited, and when there are so many different modes of explaining appearances, it behoves an author to use more than ordinary caution against the mention of anything that is not strictly in accordance with ascertained physical laws. On both these points the present book is at fault. As an instance, the author mentions M. Faye's theory of the repulsive power of the sun in virtue of its heat, and then urges objections to the theory without a word of explanation of it. Now to a person not conversant with the experiments on the repulsion of gases and solids by heat rays, the theory would seem absurd and contrary to experience; and so the author carries the day with the theory that the effect of solar heat upon the cometary matter is electrical in its action. Again, he says: "For example, the matter of comets is not possessed of concentric attraction even with reference to itself, neither is it possessed of chemical affinity for itself. This is fully established by the eccentric forms of comets and through conspicuous variations of shape and size." This is quite new to us. Again, after mentioning that Lexell's comet was entangled for about a month among the satellites of Jupiter, he says: "Is there another instance—a single analogy on record outside of cometary phenomena—of a body of dead matter under great velocity being actually barred and stopped in its path for four months, and then suddenly starting off again after being divested of its force for so long a period? What can the composition and resolution of forces do for us here? for here is the most wonderful problem ever submitted to their laws. What must be the amazing force of a body which, like an unspent cannon-ball impeded by a bank of earth, keeps spinning and grinding in its bed for four months, and then suddenly goes off with unabated velocity as if it were merely ricochetting from its point of interruption?"

Did the writer never hear that the motion of this comet was in strict accordance with the laws of gravitation, and Laplace used it for corrrecting the value of Jupiter's mass? In these cases, and in many others, the author has gone sadly astray. The accounts of the appearance of the different comets are good and clear and are well worth reading, but one or two drawings of comets would have improved matters considerably. There is a plate at the beginning of the book, of the earth in a comet's tail, which draws somewhat on the imagination. A want of soundness with reference to mechanical laws appears throughout the book, for we read of the two parts of Biela's Comet having less mass to be acted upon by solar attraction than they had before separation, so that the original orbit must have been altered; and we hear of a comet altering capriciously its centre of gravity with reference to solar attraction. The words orbit*u*al and phosphor*o*us occur frequently, we hope for the last time. The book is spoilt by the endeavour to explain the appearances of comets without regard to the most fundamental physical laws which have so far been found to be rigorously exact.

G. M. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Pollen-grains in the Air

MR. HUBERT AIRY's letter printed in your issue of Sept. 3 appears, to a great extent, to reconcile that gentleman's observations with my own. My set of drawings have been made entirely from pollen-grains in the *dry* state, and in this condition (in which of course it is wafted through the air) I find the pollen of plants fertilised by the wind, though belonging to the most widely dissociated natural orders, to be uniformly, as far as I have been able to observe, nearly or perfectly spherical, with no prominences or furrows visible on magnifying about 250. A very short immersion in glycerine would cause the protrusion of the intine through the weak spots of the extine, and would give to the grains of birch and hazel the spherically triangular appearance described by Mr. Airy, and represented in some of the plates by an old German writer.

ALFRED W. BENNETT

Penmaenmawr, Sept. 9

Fossils in Trap

WHEN examining the great exposure of trap and associated Upper Silurian rocks at Cape Bon Ami, New Brunswick, I unexpectedly found fossils in the trap. I was at the time collecting agates and amygdals of calcite. One amygdal attracted my attention as singularly regular in shape. On detaching it from the rock and examining it with the magnifying glass, I found it to be a coral, *Favosites gothlandica*. The fossil is nearly circular. Its greatest diameter is $1\frac{7}{10}$ in., its smallest diameter $1\frac{4}{10}$ in., its greatest thickness is $\frac{1}{2}$ in. Notwithstanding the rubbing by exposure on the shore, many of the cells are quite distinct: the side attached to the trap is without cells. I found a second specimen of a similar coral in another part of the trap-rock. Of this the length is 1 in., the width $\frac{4}{10}$. The exposed part is a section having the structure perfect; it is slightly weathered. The fossil is indissolubly united with the trap, its sharp septa penetrating it: the trap of the specimen is very compact.

These fossils are derived from the associated strata of Niagara limestone: Wenlock limestone age.

The strata have been coral reefs: they are filled with corals, *Favosites* and *Cyathophylla*. I collected magnificent specimens of the former, also *Crinoid* joint, *Orthis* sp.? *Strophomena depressa*, *Atrypa reticularis*, *Rhynchonella* sp., *Athyris nitida*, *Orthoceras* sp.?

The fossils are easily detached from the strata.

I have no doubt that the notice of the occurrence of the fossils in trap will be new to many of your readers. In all my investigations I have not met with a similar occurrence. The first example proves that the trap was, at least, in a *plastic* state when the fossil dropped into it. The second proves that it was in a *fluid* state.

This is all very satisfactory to us, as proving that trap is a true *lava*, although the Wernerian might thereby infer that the trap was a sedimentary rock. The section of the coral in the trap is as perfect as sections of *Lithostrontion* in the Lower Carboniferous limestone of East River Picton in our museum collection.

By what process were these fossils preserved from destruction in the molten trap?

D. HONEYMAN

Halifax, Nova Scotia, Aug. 27

[Our correspondent does not define in what sense he uses the vague word "trap." Fossils, both animal and vegetable, are of common occurrence in some kinds of "trap," *e.g.* in the different forms of tuff. We presume that the specimens he refers to were of true basalt, or some other form of crystalline, and once molten igneous rock. If so the fact is interesting, though possibly some of our readers may be able to adduce similar cases.—ED.]

Curious Rainbow

THREE or four days ago I observed a phenomenon which may, possibly be interesting to some of your readers. I was standing on a hillside, about 200 ft. above the sea, and saw a rainbow of the ordinary description, very vivid and extending to the horizon at both ends of the arch; outside this was a secondary bow, also very distinct, and inside the primary bow was a series of coloured bands, to all appearance identical with the series in the primary bow from the green to the violet, so placed that the green of this third bow was next to the violet of the primary bow, and the violet of the third bow the innermost of all. There was no appearance of any superposition of colours, and the third bow was nearly as bright as the primary, and the interval between them was hardly appreciable. The whole series was concentric. I have not observed any notice, in works on the subject, of a phenomenon similar to this, or any hint that it might be expected according to the geometrical or physical theories of the rainbow, and therefore think the appearance may possibly be of rare occurrence.

R. P. A. SWETTENHAM

Glen Caladh, Kyles of Bute, Sept. 5

Polarisation of the Aurora

IN answer to Mr. Procter's first question (vol. x. p. 355), I would refer him to NATURE, vol. vii., p. 201, where he will find an account of observations of the polarisation of the zodiacal light, and of the aurora, by Mr. Ranyard, who appears to have used a double image prism and Savart, during the great aurora of Feb. 4, 1872, and to have detected no polarisation. He refers also to some observations made upon the small aurora of Nov. 11, 1871, in which he could detect no polarisation. The only other account of observations that I have met with are contained in the report of Prof. Stephen Alexander on his expedition to Labrador, given in Appendix 21 of the United States Coast Survey Report for 1860, p. 30. He found strong polarisation with a Savart's polariscope, and, what is most remarkable, thought that the dark parts of the aurora gave the strongest polarisation. This was at the beginning of July. He was in latitude about 60°, and the observations appear to have been made near midnight. But he does not state whether there was twilight or traces of air polarisation at the time, nor does he give the plane of polarisation.

Cheltenham

J. A. FLEMING

FRANCIS EDMUND ANSTIE, M.D., F.R.C.P.

ON Saturday, 12th inst., in his forty-first year, after an illness of only four days' duration, died Dr. F. E. Anstie, from the consequences of a dissection-wound inflicted while he was investigating the causes of a serious and somewhat mysterious disease which had for some time prevailed in a large school at Wandsworth, and had rapidly carried off several of the pupils. Thus he must be enrolled in the list of those who have fallen in the cause of scientific investigation.

Dr. Anstie was a student of King's College, and took his doctor's degree at the University of London in 1858, since which time he has devoted much of his leisure to the investigation of therapeutical and pathological problems. His work on "Stimulants and Narcotics," published in 1864, first brought him into notice as an upholder of the value of alcohol as a nutritive agent, in contradistinction to the opinion of M. Lallemand, that its action is simply stimulant. In conjunction with Dr. Burdon-Sanderson he was one of the first in this country to direct attention to the Sphygmograph of his friend Prof. Marey, of Paris. Sanitary reform was another subject to which Dr. Anstie paid much attention, and with great success. His article on "Neuralgia" in Reynolds' "System of Medicine," and his important work on the same subject, made him well known as a physician, as did his papers in the *Practitioner*, of which he was the editor.

Dr. Anstie was physician to Westminster Hospital, where he was also lecturer on Medicine. The new physiological laboratory of that institution, which is to be opened next month, owes much to his energy; and no one, more than himself, looked forward to the opportunities it will afford for original investigation. Dr. Anstie's loss will be felt by a large circle of friends, whom he had an unusual power in making and retaining, on account of the genuineness and force of his character.

HIEROGLYPHIC TABLETS AND SCULPTURE IN EASTER ISLAND

EARLY last spring mention was made in NATURE (vol. ix. p. 351) of some photographs of inscribed tablets from Easter Island, which the Academy of Sciences at San Francisco had shortly before received from Mr. Croft, of Papeeti, Tahiti.

Up to that time only three tablets were known for certain to have been discovered in the island. From information, however, which has recently been received, it appears that there are now no less than five tablets at the Roman Catholic Mission in Tahiti; and one, obtained last year by the mate of a vessel wrecked on the island, is said to have been taken to San Francisco. Two others are in the National Museum at Santiago de Chili;[*] and casts from these, made under Mr. E. Reed's directions, were sent to England and Germany in 1873. This, however, is not all. Natives who are in the employ of planters at Papeeti inform Mr. Croft that incised tablets were formerly very numerous in Easter Island, but many were destroyed in intestine wars. Some are said to have contained descriptions of land and boundaries; others, directions for planting and fishing; many were connected with religion and mythology; and, more important than all, a few "contained the ancient history of the island, and its kings or ruling chiefs:" these, it was feared, might all have been destroyed, not by the natives themselves, but by direction of Roman Catholic priests, who, as in America at the time of the Spanish conquest, persuaded their first converts to burn and destroy a large number of records without discrimination. It is known, however, that a few remain in possession of the islanders, who are said to attach the greatest possible value to them.

Should no others prove to be historical, it is almost certain that one, at least, of those at Santiago, of which we have the plaster casts, answers this description. The tablet alluded to is fully described in the *Journal of the Anthropological Institute*,[†] where plates will be found of the hieroglyphics.

Some of the older natives of Easter Island are said still to possess the art of engraving tablets, and to be able to interpret them. But whether this refers to the ancient signs, or only to those which Señor G. de la Rosa found were used by the chiefs a hundred years ago, is at present doubtful. Dr. Philippi, of the University of Santiago, on the authority of Père Einaud, one of the French missionaries, says that the natives do not attach any meaning to the signs. Probably expert wood-carvers like the Easter Islanders would from time to time have replaced decayed tablets and multiplied others. They may also, very possibly, know from the general appearance of the hieroglyphics what they refer to, and yet not understand individual signs.

Before showing that it may prove an easy task for anyone acquainted with the Pacific to interpret the signs, provided he has some knowledge of the traditions of the Easter Islanders, it will be necessary to mention the legend of their origin as ascertained by Commodore Powell and Señor Gana from the missionaries on the spot (in 1868 and 1870). It is briefly this: that their ancestors arrived in two boats many years ago, each boat being under the command of a chief; and there is a distinct tradition that they had been expelled from Oparo, or Rapa-iti, an island 1,600 miles to the west.

Now there is a drift-current from that direction, that carries wood and other waifs to the shores of Easter Island; so that it is physically possible for a canoe or other vessel to have arrived by its aid. It is worth mentioning that the current turns round Easter Island, and then goes northwards.

Oparo, also, bears silent witness to the truth of the story. Though little more than seven miles in length, several of its hills are capped with stone forts; and there are platforms and stone houses as in Easter Island, as well as a fortress or temple in five stages (like the ruin of Pollanarrua, in Ceylon). It need scarcely be added that there are traditions of fierce wars and feuds in the island.[*] Unfortunately, little more than this is known about its antiquities and legends.

Passing by, with the bare mention, several symbolic practices of the Easter Islanders—for example, the enormous trouble that was taken by them to crown the great statues with huge tiaras of red tufa; the erection of effigies of their chiefs on platforms of squared stone, the masonry of which, Cook said, was "equal to any in England;" the peculiar form of the huts, like inverted boats; their moon-shaped shields, used only in dances (some with faces carved on the cusps, like the eagles' heads on the Phrygian peltas); the bi-fronted staffs or batons, which were held in the hands of the chiefs; and tattoo marks like those in Burmah and India,—all of which may possibly, by and by, aid us in discovering the land from which the mysterious chiefs of Easter Island originally came,—passing by these, we will confine our attention to the symbols which appear more immediately to relate to the arrival of vessels from Oparo, and seem to establish the tradition on an historical basis.

Few who have visited the Cnidus Shed at the British Museum can have failed to notice the emblematic carving on the back of one of the statues from Easter Island, at present deposited there. It was found under cover in the range of stone houses called "Taura Renga," in the centre of a chamber lined with wall slabs, and partly excavated from the cliff. The bas-reliefs faced the entrance, a small square door, with stone posts and lintel, in a rubble wall about 5 ft. in thickness. On the back of the head of the statue there is a bird, over which is a solar crown; and on either side a rapa, or steering paddle, with a human face on the spade-like blade.[†] A third but very much smaller rapa is carved on the back of the right ear of the statue, whilst four ovals are incised on the left. The lobes of both ears are greatly lengthened.

---

[*] Two more are reported to have been taken by a surveying ship to Russia a few years ago, and another to Germany.

[†] Journ. Anthro Inst., Jan. 1874. Trubner and Co.

[*] Captain Vine Hall, who spent a few hours there a year or two ago, gives the above particulars.

[†] There are wooden rapas in Easter Island, which are used only in the native dances.

Lower down on the back of the statue there are two herronias—symbolic animals, with albatross-like beaks, which are turned, not ungracefully, towards the bird. Immediately above the waist-belt of the statue—its only dress—there is a circle.

The explanation of these hieroglyphics is at once suggested by the story of the arrival of the chiefs. The two rapas, or steering paddles, were dedicated to the gods, and symbolise the vessels of the two chiefs. They were doubtless carved on the statue to commemorate their safe arrival. The two herronias may represent the chiefs themselves. The circle is the accepted emblem of life.

The same symbolism, though of a more realistic kind, may be recognised in the curious wooden images which are peculiar to Easter Island. They are mostly anatomical; that is, figures in which the ribs, vertebræ, and other bones are distinctly shown, as they would appear in a person suffering from extreme emaciation. They were styled by La Pérousse "squelettes." Nearly all of them have strongly marked Semitic features, a tuft on the chin, and highly symbolic carvings on the scalp; *e.g.*, herronias, double-headed birds, and a solar deity with rays round the head. The legs of these little images are uniformly short, and the ear-lobes enlarged. There is also very generally, if not always, a circle on the lower part of the back. It can hardly be doubted, in view of the symbolism which pervades almost everything in Easter Island, that these squelettes are connected with the story of the voyage from Oparo, and represent the half-starved condition in which it may well be conceived that the crews arrived.

In one of these images, in the Ethnographical Room at the British Museum, the head is perfectly smooth, which appears to intimate that it was shaven. It perhaps represents a priest; for we are informed that Roggewein, the discoverer of Easter Island in 1720, noticed a native with his head shaved, who had large "white balls" in his ears, and appeared very devout: the Dutch judged him to be a priest.

Returning to the tablets, of which casts are in the museum of the Anthropological Institute, it will be sufficient to mention that they are engraved with hieroglyphics on both sides, every part being covered with minute signs, apparently intended as actual representations of various forms of animal and vegetable life; as well as scenes and incidents such as were likely to have been met with among the islands in the Pacific. On the bottom line of what is considered to be the front face of the smaller tablet there is a procession of bird-headed men, who are approaching or standing before a pillar, or stone,[*] with two discs, or circles, on each side. Immediately before the first figure, which it is presumed is a chief, from his holding a staff in his hand, are two curved lines, the hieroglyphic for a boat or canoe. Behind the chief another bird-headed man is represented as kneeling down, and holding up his hands; he is probably a priest.[†] A third bird-headed figure follows without a staff. Then, after two small curves high up in the line of hieroglyphics—perhaps a sign for the moon,—there is a character with a bird's head and beak, of a different shape from those of the bird-headed men. It has a crest on its head, and short wings, and is probably intended for a domestic fowl—the only land bird in Easter Island. It appears to be a victim about to be sacrificed. Two more bird-headed men, without staffs, follow in a certain stately order. Then there is a second sign or hieroglyphic for a boat, followed by another chief; and then a third sign for a boat, with a waved or zigzag line before it, which is perhaps intended to signify that the vessel which follows it was lost or driven away in some other direction by a storm. This last boat is followed by a bird-headed man without a staff.

The signs for the chiefs' vessels, it will be seen, agree in number with the large rapas, or steering paddles, upon the back of the stone statue; and the bird-headed chiefs answer to the two herronias. The diminutive steering paddle, represented apart from the others on the ear of the statue, may symbolise the same casualty that appears to be signified by the waved line, viz., that there was a third boat, which did not reach Easter Island. The small carving of a rapa would thus have been erected merely *in memoriam*. However this may be, taken in conjunction with the tradition, there can be little doubt that the hieroglyphics on the tablet and the carvings on the statue relate to a more important matter than the arrival of the chiefs.

As regards the signs generally, a considerable number have been identified as conventional representations of birds and animals which are not found in Easter Island; weapons, also, and other objects are introduced (*e.g.*, an Eastern bow), which belong to regions far to the west. Some of the identifications that have been suggested may be doubtful; but amongst those that will perhaps meet with general acceptance, by no means the least important are the hieroglyphics of three distinct types of men: (1) Tall, bird-headed men, with short legs, as in the wooden images. (2) Men with large ornaments or projections on each side the head, scarcely exaggerating the practice of enlarging the ear-lobes by inserting in them discs, or plugs of wood and other materials, which prevails in certain islands in the Pacific, as well as amongst the older races in India and Burmah. (3) Dog-faced men, or Negritos, with strangely shaped heads, which, from plates in the "Cruise of the *Curaçoa*," appear to be characteristic of the natives of the Solomon Islands, as well as the more westerly islands of the Fiji group. They squat like the dog-faced men in the tablets, whilst the large-eared men sit in the Eastern manner. The peculiar appearance of the head is explained by the custom of dressing and plastering the hair. Several of these Negritos are represented about the middle of the tablet as celebrating a fish-fête; the men dancing by themselves on one side, and the women in couples on the other. Two of the men with enlarged ear-lobes stand by as spectators.

Enough has perhaps been said to suggest the great importance of an early and systematic exploration, above and below ground, of Easter Island and Oparo, as almost unworked mines, abounding in matter of the greatest ethnological and anthropological interest.

J. PARK HARRISON

---

[*] Compare the legend of the "Emigration of Turi," Pol. Myth p. 214. "Amongst the chiefs who landed there was one called Porua . . . the second (dog) they cut up raw as an offering for the gods . . . and built a second place, *and set up pillars for the spirits*."

[†] See Pol. Myth. p. 136, where a priest is mentioned as accompanying a boat expedition.

ON THE DISTRIBUTION OF THE HEAT DEVELOPED BY COLLISION[*]

MANY of our colleagues who have become aware of a fact in thermodynamics which it has been in our power recently to observe, think it possessed of so great an interest that I ought immediately to announce it to the Academy. It is as follows:—

During the forging, which has been very successful, of the ingot of platino-iridium for the standard metre, I at first remarked that it sometimes produced, under the action of the hammer, luminous streaks, having an oblique direction upon the lateral faces of the piece, when this, while cooling, was yet at the temperature of a dull red. I showed some of these effects to M. Fizeau, but they were then incomplete, and I have only lately succeeded in obtaining a good observation of the phenomenon, and in defining its character with perfect certainty.

---

[*] A paper read by M. Tresca before the Paris Academy of Sciences June 8.

It is known that when a bar of metal is lengthened by means of a powerful hammer on an anvil of the same form as the head of the latter, each blow produces, above and below, a symmetrical contraction, the effect of which is to give to the bar the aspect of a series of projections separated by small level spaces.

At the time of the collision, these spaces, which are formed before and behind the impress of the hammer, upon the upper and the lower face of the bar, are connected, at a certain moment, upon the lateral faces, by luminous lines passing from the one to the other, and presenting altogether the appearance of an X written in lines of fire. The phenomenon is only visible for a certain temperature of bar which is being wrought, but then each blow invariably produces its effect, and, in consequence of the confused mingling of the imprints, we see the entanglement of these crossed lines which encroach upon each other. These brilliant bands appear at the same moment as the collision, but they do not disappear with it, and their continuance was sufficiently prolonged to enable us to count six luminous cross-bars visible at one time, although developed by six successive blows of the hammer.

I have been able, moreover, to get this persistence confirmed by several persons in the foundries of M. Farcot, who, with the greatest kindness, placed his services at the disposal of the Metric Commission for the execution of the work.

Although the lines of the cross-bars appeared to us all rectilinear, and although we could not compare them to anything better than two series of straight lines, parallel and intercrossed, we think it will be indispensable to determine their form more exactly by appropriate processes, and to discuss it with the greatest care.

It is well known that hammering develops heat in the bodies hammered; thermodynamics teaches us that these thermal effects ought to be regarded as the result of mechanical work or of *demi-force vive* exerted during the collision, but the precise place in which the calorific development is produced has not yet been noticed.

For ourselves, we do not hesitate to affirm that the zone which becomes luminous is that along which the matter mainly flows, at the moment when the change of form takes place, according to a law which we were enabled to discover in our previous researches in molecular displacements. If this first indication should be confirmed, there would be thus obtained a more exact knowledge of the mode of distortion determined by the forging, and the phenomenon which we describe would evidently form a new scientific connection between thermodynamics and the question with which we ourselves are personally occupied under the title of "Flowing of Solid Bodies."

The phenomenon ought to be the same for all metals, and we have already ventured to hazard some considerations of the particular causes of the brightness which it presented in the case of platinum, and which has not, so far as we know, been yet observed in any other forging.

The exceptional hardness of the platino-iridium, cooled to a dull red heat, requires, for an equal distortion, an amount of work at least equivalent to that of the forging of steel, and in consequence of the relative smallness of the calorific capacity of this alloy, this same work ought to be converted into calorific phenomena, more localised and more intense. Moreover, the material is more homogeneous than iron, and is notable for a kind of remarkable translucency which makes one believe that the eye can follow the shade of red to a certain depth. The effects, whatever they may be, are thus rendered more manifest, more especially as they are not accompanied by any exudation of foreign matter nor by any oxidation of the surface. All these circumstances are eminently favourable to the observation which chance permitted us to make, and which, once confirmed in the case of platinum, may certainly be renewed with other metals, although possibly in a more restricted manner than in the case of the alloy of MM. Deville and Debray.

We confine ourselves for the present to a summary indication of the principal fact, which appears to us to have a certain importance, and which consists in this appearance of luminous bands which arise from collision, and the position of which enables us to fix the precise place where is developed the heat which represents under another form the work done by motion. This fact is, perhaps, of a nature to open some new path for the researches, so carefully made, of the physicists of our epoch on all that touches on molecular mechanics and on the calorific actions which are connected with them.

The ingot of platinum has already been brought into the form of a bar with a square section of 4·50 m. in length; there will be a chance of continuing the same observations in the new operations of forging to which it will be submitted; the chance of renewing them may perhaps not again be offered.

SUBJECTS FOR PRIZES PROPOSED BY THE HAARLEM SOCIETY OF SCIENCES

THE following subjects for prizes are proposed by the Haarlem Society of Sciences:—

I. Competition of 1875, the limit of which is fixed on Jan. 1, 1875.

1. To give for ten sorts of glass of known chemical composition—(*a*) The coefficients of dilatation between 0° and (at the most) 100°, having regard to the influence of the tempering and the state of tension; (*b*) The coefficients of elasticity with exact indication of the temperatures; (*c*) The indices of refraction for at least ten points distributed over the whole extent of the spectrum, also with precise indication of the temperature.

2. Does the coefficient of dilatation of steel vary with the degree of tempering, and can we establish empirical laws on the subject of the connection between these two elements?

3. Can there be established by experiment a connection between the diffusion of liquids through porous partitions and other phenomena, such as capillarity, &c.?

4. Determine the coefficient of dilatation for at least three liquids of simple composition, according to the process by which the absolute dilatation of mercury has been established.

5. Researches are sought on the origin of sensitive organs, especially of the visual organ, among some of the inferior animals; this origin being considered, as far as possible, in relation to the conditions in which the animal is found, and the external influences to which it is subject.

6. In terrestrial magnetism, what are the periods known with sufficient accuracy, and how far have these periods been proved to be connected with cosmical or telluric phenomena?

7. New experiments and observations are wanted to clear up the following question:—How are albumenoid matters formed and removed in plants?

8. Determine exactly the density, the coefficient of dilatation, the point of fusion, the point of ebullition, the specific heat, the index of refraction, and the specific rotatory power of at least twenty organic combinations, pairs of which are isomeric and whose chemical composition is known.

9. The experiments of M. Regnault on the specific heat of certain terpenes, and those of M. Berthelot on diamylene and triamylene, having shown that the specific heat of polymeric bodies of one combination may be equal to that of the fundamental matter from which they originate, it is desired that these researches be extended to as great a number as possible of other combinations having between them the same relations, for the purpose of deciding if the observed fact may or may not be raised to the rank of a general law.

10 New researches are sought on tetraphenol and its derivatives, for the purpose of deciding on the value of the *hypothesis* of M. Limpricht concerning the existence of a series of aromatic matters with a nucleus composed of four atoms of carbon.

11. Give a critical sketch of experiments and observations concerning the existence of *Bacteria* in contagious diseases, followed by original researches on the same question investigated in one or more of these maladies.

12. New experiments are asked on the mode of growth of bone, of such a kind as to abolish the differences of opinion founded upon results apparently contradictory, announced in recent years by various experimenters.

13. A thorough investigation is wanted of some of the species of Linnæus, chosen from among those which present more or less of varied forms. These species ought to be wild (*spontanées*) plants, to the number of ten at least, and of twenty or more, belonging to two natural families at least, and inhabiting well-explored countries, such as Europe, the United States, &c. The author ought to discover, describe, and classify all the forms more or less distinct, and more or less hereditary, which are included in the Linnean species, being careful to intimate their habitat, their station. He ought to study their mode of fecundation, and to judge how far certain forms may be attributed to crossing. The classification of forms into species, races, varieties, and other subdivisions as may be necessary, ought to be based at once upon the external forms and on the more intimate affinities demonstrated by fecundation and grafting.

II. For competition in 1876, for which the limit is fixed on Jan. 1, 1876.

1. Exact researches are asked for concerning the dissolving power of water, and of water charged with carbonic acid, for gypsum, chalk, and dolomite, at different temperatures and pressures, and in the case of the simultaneous presence of marine salt and other common soluble salts.

2. The same is asked for silex and the most common natural silicates.

3. To submit to a new investigation the structure of the kidneys of Mammalia, specially in reference to the epithelial lining of the different parts of the renal tubes.

4. A critical examination of recent researches from which it would appear to result that the peptones of different albumenoid matters are mixtures of substances in part already known and partly yet unknown. This critical examination should be completed by personal researches.

5. To determine exactly in Weber units, the resistance of a column of mercury of one metre in length and of one square millimetre in section, at 0°.

6. To make better known, by careful experiments, the relation between the two kinds of electrical units, electro-magnetic units and electro-static units.

7. New experiments tending to determine the influence of pressure on chemical action.

The prize offered by the Society for each of these questions consists (at the choice of the competitors) either of a gold medal bearing the ordinary stamp of the Society, along with the name of the author and the date, or a sum of 150 florins. A supplementary premium of 150 florins may, moreover, be awarded if any memoir is deemed worthy of it. The memoirs sent for competition ought to be written in one of the following languages:—French, Dutch, English, Italian, Latin, or German (but not in German character). They ought to be accompanied by a sealed envelope containing the name of the author, who ought not to make himself otherwise known.

COMMON WILD FLOWERS CONSIDERED IN RELATION TO INSECTS[*]

AT the close of the last century, Conrad Sprengel published a most valuable work on Flowers, in which he pointed out that their forms and colours, their scent, honey, and general structure, have reference to the visits of insects, which are of importance to Flowers in transferring the pollen from the stamens to the pistil. Sprengel's admirable work, however, did not attract the attention it deserved, and remained comparatively unknown until Mr. Darwin devoted himself to the subject. Our illustrious countryman was the first to perceive that insects are of importance to Flowers, not only in transferring the pollen from the stamens to the pistil, but in transferring it from the stamens of one flower to the pistil of another. Sprengel had, indeed, observed in more than one instance that this was the case; but he did not appreciate the importance of the fact. Mr. Darwin's remarkable memoir on Primula, to which I shall again have occasion to refer more than once, was published in 1862; in this treatise the importance of cross-fertilisation, as it may be called, was conclusively proved, and he has since illustrated the same rule by a number of researches on Orchids, Linum, Lythrum, and a variety of other plants. The new impulse thus given to the study of Flowers has been followed up in this country by Hooker, Ogle, Bennett, and other naturalists, and on the Continent by Axell, Delpino, Hildebrand, and especially by Dr. H. Muller, who has published an excellent work on the subject, bringing together the observations of others and adding to them an immense number of his own.

Everyone knows how important flowers are to insects; everyone knows that bees, butterflies, &c., derive the main part of their nourishment from the honey or pollen of flowers; but comparatively few are aware, on the other hand, how much the flowers themselves are dependent on insects.

Yet it is not too much to say, if flowers are very useful to insects, insects, on the other hand, are in many cases absolutely necessary to flowers; that if insects have been in some respects modified and adapted with a view to the acquirement of honey and pollen; flowers, on the other hand, owe their scent and colours, nay, their very existence in the present form, to insects. Not only have the brilliant colours, the smell, and the honey of flowers been gradually developed under the action of natural selection to encourage the visits of insects, but the very arrangement of the colours, the circular bands and radiating lines,[*] the form, size, and position of the petals, are arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which renders these visits necessary. Thus the lines and bands by which so many flowers are ornamented have reference to the position of the honey; and it may be observed that these honey-guides are absent in night-flowers, where of course they would not show, and would therefore be useless, as, for instance, in *Lychnis vespertina*, or *Silene nutans*. Night-flowers, moreover, are generally pale; for instance, *Lychnis vespertina* is white, while *Lychnis diurna* which flowers by day is red.

That the colour of the corolla has reference to the visits of insects is well shown by the case of flowers, which—as, for instance, the ray or outside florets of *Centaurea cyanus*—have neither stamens nor pistils, and serve, therefore, exclusively to render the flower-head more conspicuous. The calyx, moreover, is usually green; but when the position of the flower is such that it is much exposed, it becomes brightly coloured, as, for instance, in the Berberry.

If it be objected to me that I am *assuming* the existence of these gradual modifications, I should reply that it is not here my purpose to discuss the doctrine of Natural Selection. I may, however, remind the reader that Mr. Darwin's theory is based on the following considerations:—1. That no two animals or plants in nature are identical in all respects. 2. That the offspring tend to inherit the peculiarities of their parents. 3. That of those which come into existence only a certain number reach maturity. 4. That those which are, on the whole, best adapted to the circumstances in which they are placed, are most likely to leave descendants.

No one of these statements is, or can be, disputed, and they seem fully to justify the conclusions which Mr. Darwin has deduced from them, though not all those which have been attributed to him by his opponents.

Now, applying these considerations to flowers, if it is an advantage to them that they should be visited by insects (and that this is so will presently be shown), then it is obvious that those flowers which, either by their larger size, or brighter colour, or sweeter scent, or greater richness in honey, are most attractive to insects, will, *cæteris paribus*, have an advantage in the struggle for existence, and be most likely to perpetuate their race.

There are, indeed, other ways in which insects may be useful to plants. Thus, a species of acacia mentioned by Mr. Belt,[†] if unprotected, is apt to be stripped of its leaves by a species of leaf-cutting ant, which uses the leaves, not directly for food, but, according to Mr. Belt, to grow mushrooms on.

The acacia, however, bears hollow thorns, and each leaflet produces honey in a crater-formed gland at the base, and a small, sweet, pear-shaped body at the tip. In consequence it is inhabited by myriads of a small ant, *Pseudomyrma bicolor*, which nests in the hollow thorns, and thus finds meat, drink, and lodging all provided for it. These ants are continually roaming over the plant, and constitute a most efficient bodyguard, not only driving off the leaf-cutting ants, but even in Mr. Belt's opinion rendering it less liable to be eaten by herbivorous mammalia.

---

[*] Address by Sir John Lubbock, Bart., F.R.S., at the Belfast meeting of the British Association, August 1874.

[*] I did not realise the importance of these guiding marks until, by experiments on bees, I saw what difficulty they experience if honey, which is put out for them, is moved even slightly from its usual place.

[†] F. Müller has observed similar facts in Sta. Catharina. (NATURE, vol. x. p. 102.)

We are now, however, more immediately concerned with bees and flowers.

Many flowers close their petals during rain, which is obviously an advantage, since it prevents the honey and pollen from being spoilt or washed away. Everybody, however, has observed that even in fine weather certain flowers close at particular hours. This habit of going to sleep is surely very curious. Why should flowers do so?

In animals we can understand it; they are tired and require rest. But why should flowers sleep? Why should some flowers do so and not others? Moreover, different flowers keep different hours. The daisy opens at sunrise and closes at sunset, whence its name "day's eye." The dandelion (*Leontodon taraxacum*) is said to open at seven and close at five, *Arenaria rubra* to be open from nine to three, *Nymphæa alba* from about seven to four: The common Mouse-ear Hawkweed (*Hieracium pilosella*) is said to waken at eight and go to sleep at two; the scarlet pimpernel (*Anagallis arvensis*) to wake at seven and close soon after two; while *Tragopogon pratensis* opens at four in the morning, and closes just before twelve, whence its English name, "John go to bed at noon." Farmers' boys in some parts are said to regulate their dinner-time by it. Other flowers, on the contrary, open in the evening.

Now, it is obvious that flowers which are fertilised by night-flying insects would derive no advantage from being open by day; and, on the other hand, that those which are fertilised by bees would gain nothing by being open at night. Nay, it would be a distinct disadvantage, because it would render them liable to be robbed of their honey and pollen, by insects which are not capable of fertilising them. I would venture to suggest, then, that the closing of flowers may have reference to the habits of insects, and it may be observed also in support of this that wind-fertilised flowers never sleep;* and that some of those flowers which attract insects by smell emit their scent at particular hours: thus, *Hesperis matronalis* and *Lychnis vespertina* smell in the evening, and *Orchis bifolia* is particularly sweet at night.

I now pass to the structure and modification of flowers. A perfect flower consists of (1) an outer envelope or *calyx*, sometimes tubular, sometimes consisting of separate leaves, called *sepals*; (2) an inner envelope or *corolla*, which is generally more or less coloured, and which, like the calyx, is sometimes tubular, sometimes composed of separate leaves, called *petals*; (3) of one or more *stamens*, consisting of a stalk or *filament*, and a head or *anther*, in which the pollen is produced; and (4) a *pistil*, which is situated in the centre of the flower, and consists generally of three principal parts—one or more *carpels* at the base, each containing one or more seeds; the stalk or *style*; and thirdly the *stigma*, which in many familiar instances forms a small head at the top of the style or ovary, to which the pollen must find its way in order to fertilise the flower. In some cases the stigma is sessile. Thus it will be seen that the pistil is normally surrounded by a row of stamens, and it would seem at first sight a very simple matter that the pollen of the latter should fall on the former.

This in fact does happen in many cases, and flowers which thus fertilise themselves have evidently one great advantage—few remain sterile for want of pollen. Everyone, however, who has watched flowers and has observed how assiduously they are visited by insects, will admit that these insects must often deposit on the stigma, pollen brought from other plants, generally of the same species. For it is a remarkable fact that in most cases bees confine themselves in each journey to a single species of plant, though in the case of some very nearly allied forms this is not so; for instance, it is stated on good authority that *Ranunculus acris*, *R. repens*, and *R. bulbosus* are not distinguished by the bees, or at least are visited indifferently, as is also the case with two of the species of clover, *Trifolium fragiferum* and *T. repens*. Now, it is clear, both from the structure of flowers and also from direct experiment, that as a general rule it is an advantage to flowers to be fertilised by pollen from a different plant.

I will not now enter on the large question why this confertilisation should be an advantage; but that it is so has been clearly proved. It has long been known that hybrids between different varieties are often remarkably strong and vigorous; Kolrenter speaks with astonishment of the "*statura portentosa*" of some plants thus raised by him; indeed, says Mr. Darwin,* all experimenters have been struck with the wonderful vigour, height, size, tenacity of life, precocity, and hardiness of their hybrid productions. Mr. Darwin himself, however, was, I believe, the first to show that if a flower is fertilised by pollen from a different plant, the seedlings so produced are much stronger than if the plant is fertilised by its own pollen. I have had the advantage of seeing several of these experiments, and the difference is certainly most striking. For instance, six crossed and six self-fertilised seeds of *Ipomœa purpurea* were grown in pairs on opposite sides of the same pots; the former reached a height of 7 ft., while the others were on an average only 5 ft. 4½ in. The first also flowered more profusely. It is also remarkable that in some cases plants are themselves more fertile if supplied with pollen from a different flower, a different variety, and even as it would appear in some cases, as in the Passion Flower, for instance, of a different species. Nay, in some cases it would seem that pollen has no effect whatever unless transferred to a different flower. In Pulmonaria, for instance, the pollen is said to be entirely without effect on the stigma of the same plant. Fritz Muller has made a variety of experiments on this interesting subject, which seem to show that in some cases, pollen, if placed on the stigma of the same flower, has no more effect than so much inorganic dust; while, which is perhaps even more extraordinary, in others the pollen placed on the stigma of the same flower acted on it like a poison. This he observed in several species: the flower faded and fell off; the pollen masses themselves, and the stigma in contact with them, shrivelled up, turned brown, and decayed; while other flowers on the same branch, which were left unfertilised, retained their freshness.

We will now pass to the consideration of the means by which self-fertilisation is checked, and cross-impregnation is effected, in plants. In some cases the pollen is simply wind-borne, in others it is carried by insects. These are attracted partly by the pollen itself, partly by the honey; while the bright colour and the scent serve to indicate the spot where the pollen and honey can be found. The calyx, which is not generally brightly coloured, probably serves as a protection to the honey, and tends to prevent bees and other insects from obtaining access to it by force

In many cases self-fertilisation is prevented by the separation of the stamens and pistils, either in the place they occupy, or the time of their maturity. They are frequently situated, either in different flowers of the same plant, as in Euphorbia, or in different plants, as in the Hop; in other cases, although the stamens and pistils are situated in the same flower, they do not mature at the same time, the anthers in some cases producing their pollen before the pistil is ready to receive it, as was first observed in *Epilobium angustifolium* by Sprengel, in the year 1790;* while in others the reverse is the case, and the pistil, on the contrary, comes to maturity before the pollen is formed. But even when the stamens and pistils are situated in the same flower and ripen at the same time, they are sometimes so placed that it is difficult for the pollen to reach the stigma.

Moreover, it appears that if a supply of pollen from another plant is secured, it is comparatively unimportant to exclude the pollen of the plant itself, for in such cases the latter is neutralised by the more powerful effect of the former.

It is also interesting to notice that the contrivances by which cross-fertilisation is favoured, or ensured, are probably of very different geological antiquity. Thus, as Muller has pointed out,† the special peculiarities of the Umbelliferæ and Compositæ have been inherited respectively from the ancestral forms of those orders; those of Delphinium, Aquilegia, Linaria, and Pedicularis, from the ancestral forms of the respective genera; those of *Polygonum fagopyrum*, *P. bistorta*, *Lonicera caprifolium*, &c, from the ancestors of those species; while in *Lysimachia vulgaris*, *Rhinanthus cristagalli*, *Veronica spicata*, *Euphrasia odontites*, and *E. officinalis*, we find that differences have arisen even within the limits of one and the same species.

The transference of the pollen from one flower to another, as I have already mentioned, is effected principally, either by the wind or by insects. In the former case the flower is rarely conspicuous; indeed, Mr. Darwin finds it "an invariable rule that when a flower is fertilised by the wind it never has a gaily-coloured corolla." The conifers, grasses, birches, poplars, &c., belong to this category.

In such plants a much larger quantity of pollen is required than where the fertilisation is effected by insects. Everyone has observed the showers of yellow pollen produced by the Scotch fir. Again, it is an advantage to these plants to flower before the leaves are out, because the latter would greatly interfere with the access of the pollen to the female flower. Hence such plants as a rule flower early in the spring. Again, in such flowers the pollen is less adherent, so that it can easily be detached by the wind,* which would manifestly be a disadvantage in the case of most of those flowers which are fertilised by insects.

---

* Sprengel, "Das entdeckte Geheimniss der Natur," p. 291.

† Animals and Plants under Domestication, ch. xvii.

* "Das entdeckte Geheimniss der Natur."

† Muller, p. 44.

Such flowers generally have the stigma more or less branched or hairy, which evidently must tend to increase their chances of catching the pollen.

It is an almost invariable rule that wind-impregnated flowers are inconspicuous, but the reverse does not hold good, and there are many flowers which, though habitually visited by insects, are not brightly coloured. In some cases flowers make up by their numbers for the want of individual conspicuousness. In others the insects are attracted by scent; indeed, as has already been mentioned, the scent, as well as the colours of flowers, has no doubt been greatly developed through natural selection, as an attraction to insects.* But though bright colours and strong odours are sufficient to attract the attention of insects, something more is required. Flowers, however sweet smelling or beautiful, would not be visited by insects unless they had some more substantial advantages to offer. These advantages are the pollen and the honey; though it appears that some flowers beguile insects by holding out the expectation of honey which does not really exist, just as some animals repel their enemies by resembling other species which are either dangerous or disagreeable.

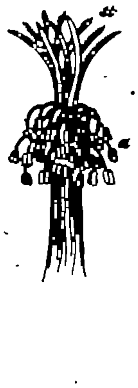


Fig. 1.

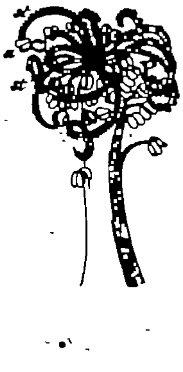


Fig. 2.

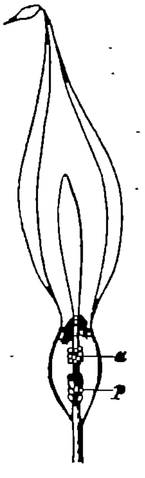


Fig. 3.

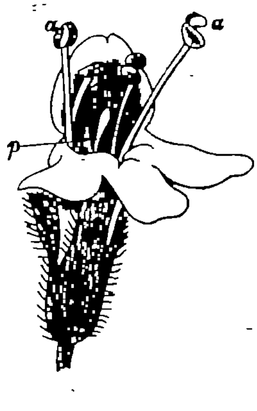


Fig. 4.

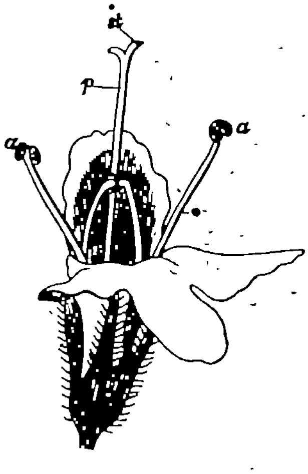


Fig. 5.

The pollen, of course, though very useful to insects, is also essential to the flower itself; but the scent and the honey, at least in their present development, are mainly useful to the plant in securing the visits of insects, and the honey also sometimes in causing the pollen to adhere to the proboscis of the insect.

Among other obvious evidences that the beauty of flowers is useful in consequence of its attracting insects, we may adduce those cases in which the transference of the pollen is effected in different manners in nearly allied plants, sometimes even in different species belonging to the same genus.

Thus, *Malva sylvestris* and *Malva rotundifolia*, which grow in the same localities, and therefore must come into competition, are nevertheless nearly equally common. In both species the young flowers contain a pyramidal group of stamens which surround the as yet immature pistil, and produce a large quantity of pollen, which cannot fail to dust any insect which may visit the flower for the sake of its honey. In *Malva sylvestris* (Fig. 1), where the branches of the stigma are so arranged that the plant cannot fertilise itself, the petals are large and conspicuous, so that the plant is visited by numerous insects; while in *Malva rotundifolia* (Fig. 2), the flowers of which are comparatively small and are rarely visited by insects, the branches of the stigma are elongated and twine themselves among the stamens, so that the flower can hardly fail to fertilise itself.

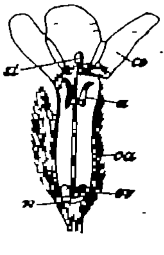


Fig. 6.

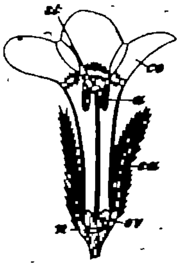


Fig. 7.

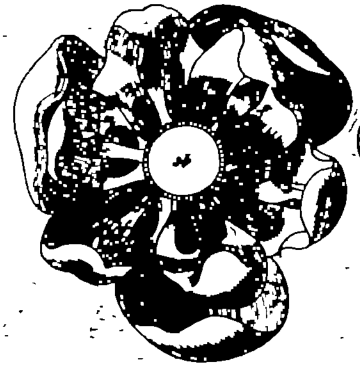


Fig. 8.

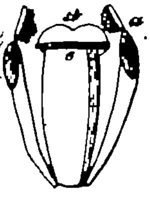


Fig. 9.

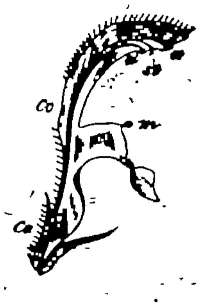


Fig. 10.

Another remarkable instance occurs in the genus Epilobium, which is, moreover, specially interesting, because in *E. angustifolium*, as I have already mentioned, the curious fact was first noticed that the pistil did not mature until the stamens had shed their pollen. *E. angustifolium* has conspicuous purplish-red flowers, in long terminal racemes, and is much frequented by insects; *E. parviflorum*, on the contrary, has small solitary flowers, and is seldom visited by insects. Now, to the former species the visits of insects are necessary, since the stamens ripen before the pistil, and the flower has consequently lost the power of self-fertilisation. In the latter, on the contrary, the stamens and pistil come to maturity at the same time, and the flower habitually fertilises itself. It is, however, no doubt sometimes crossed by the agency of insects; and indeed I am disposed to believe that this is true of all flowers which are either coloured or sweet scented. The degree in which flowers are dependent on insects differs very much, and it seems to be a general rule that in any genus where the flowers differ much in size, the largest ones are specially dependent on insects.

---

* On the other hand, it is an advantage to wind-borne seeds to be somewhat tightly attached, because they are then only removed by a high wind which is capable of carrying them some distance.

* In confirmation of this it is stated that when insects are excluded, the blossoms last longer than is otherwise the case; that when flowers are once fertilised, the corolla soon drops off, its function being performed.

As already mentioned, the self-fertilisation of flowers is in other cases still more effectually guarded against by the fact that the stamens and pistils do not ripen at the same time.

In some cases the pistil ripens before the stamens. Thus the Aristolochia has a flower which consists of a long tube with a narrow opening closed by stiff hairs which point backwards, so that it much resembles an ordinary eel-trap. Small flies enter the tube in search of honey, which from the direction of the hairs they can do easily, though on the other hand, from the same cause, it is impossible for them to return. Thus they are imprisoned in the flower; gradually, however, the pistil passes maturity, the stamens ripen and shed their pollen, by which the flies get thoroughly dusted. Then the hairs of the tube shrivel up and release the prisoners, which carry the pollen to another flower.

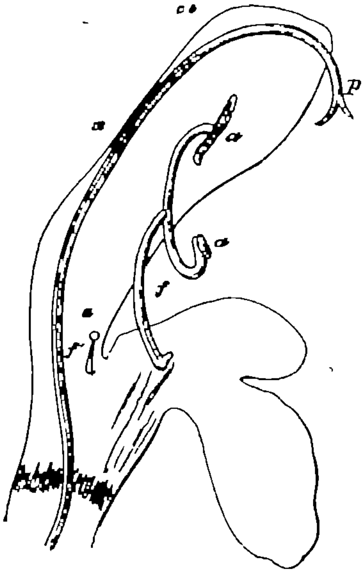


FIG. 11

Again, in the common Arum (Fig. 3), we find a somewhat similar mode of fertilisation. The well-known green leaf encloses a central pillar which supports a number of pistils near the base, and of anthers somewhat higher. Now, in this case nothing would at first sight seem easier or more natural than that the pollen from the anthers should fall on and fertilise the pistils. This, however, is not what occurs. The pistils (*p*) mature before the anthers (*a*), and by the time the pollen is shed have become incapable of fertilisation. It is impossible, therefore, that the plant should fertilise itself. Nor can the pollen be carried by wind. When it is shed it drops to the bottom of the tube, where it is so effectually sheltered that nothing short of a hurricane could dislodge it; and although Arum is common enough, still the chances against any of the pollen so dislodged being blown into the tube of another plant would be immense.

As, however, in Aristolochia, so also in Arum, small insects which, attracted by the showy central spadix, the prospect of shelter or of honey, enter the tube while the stigmas are mature, find themselves imprisoned, as the fringe of hairs, while permitting their entrance, prevents them from returning. After a while, however, the period of maturity of the stigmas is over, and each secretes a drop of honey, thus repaying the insects for their captivity. The anthers then ripen and shed their pollen, which falls on and adheres to the insects. Then the hairs gradually shrivel up and set the insects free, carrying the pollen with them, so that those which then visit another plant can hardly fail to deposit some of it on the stigmas. Sometimes more than a hundred small flies will be found in a single Arum. In these two cases there is obviously a great advantage in the fact that the stigmas arrive at maturity before the anthers. Generally, however, the advantage is the other way, and the stamens ripen before the pistil.

Of this we may take the thyme or the marjoram as an illustration. The flowers are crowded together, and as the stigmas do not come to maturity until all the anthers in the same head have shed their pollen, it is obvious that bees creeping over the flowers must transfer the pollen from the anthers of one head to the pistils of another.

FIG. 12.

Fig. 4 represents a flower of the thyme (*Thymus serpyllum*), and shows the four ripe stamens, and the short, as yet undeveloped pistil. Fig. 5, on the contrary, represents a somewhat older flower, in which the stamens are past maturity, while the pistil, on the other hand, is considerably elongated, and is ready for the reception of the pollen.

Here it is at once obvious that insects alighting on the younger (male) flowers would dust themselves with pollen, some of which, if they subsequently alighted on an older flower, they could not fail to deposit on the stigma. It should also be mentioned that in this genus there are likewise some small flowers which contain no stamens. In some cases flowers which are first male and then female, are male on the first day of opening, female on the second. In others the period is longer. Thus Nigella, according to Sprengel, is male for six days, after which the stigma comes to maturity and lasts for three or four.[*]

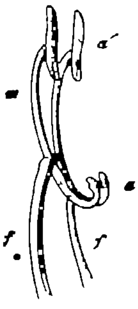


FIG. 13.

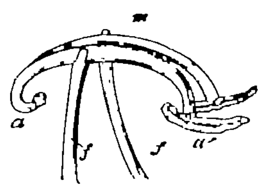


FIG. 14.

Fig. 6 represents a flower of *Myosotis versicolor*, a species often known as the Forget-me-not, when just opened. It will be observed that the pistil projects above the corolla and stamens, so that it must be first touched by any insect alighting on the flower. Gradually, however, the corolla elongates, carrying up the stamens with it, until at length they come opposite the stigma, as shown in Fig. 7. Thus, if the flower has not already been fertilised by insects, it is almost sure to fertilise *itself*.

I will now call attention in more detail to some of our common wild flowers, in order to show how beautifully they are adapted to profit by the visits of insects, and how the various parts are arranged so as to favour not only the transfer of pollen from one flower to another, but also its deposition on that part of the pistil which is especially prepared for its reception. Wherever the pistil projects beyond the stamens, it is obvious that a bee alighting on the flower would come in contact first with the former and subsequently with the latter. In flying from flower to flower, therefore, she would generally fertilise each with the pollen of one which had been previously visited.

---

[*] "Das entdeckte Geheimniss der Natur," p. 287.

Fig. 8 represents the common Berberry. *ff* represent the stamens, which lie close to the petals and almost at right angles to the pistil (*s t*), as shown in the figure. The honey-glands (*n n*) are twelve in number, situated in pairs at the base of the petals, so that the honey runs down into the angle between the bases of the stamens and of the pistil. The papillary edge of the summit of the pistil (*s t*) serves as the stigma. In open flowers of this kind it is of course obvious that insects will dust themselves with the pollen and then carry it with them to other flowers. In Berberis, however, both advantages, the dusting and the cross-fertilisation, are accomplished by a very curious contrivance. The bases of the stamens are highly irritable, and when an insect touches them the stamens spring forward (Fig. 9) and strike the insect. The effect of this is not only to shed the pollen over the insect, but also in some cases to startle it and drive it away, so that it carries the pollen, thus acquired, to another flower.

In few flowers is the adaptation of the various parts to the visits of insects more clearly and beautifully shown than in the common white Dead Nettle (*Lamium album*), Fig. 10. The honey occupies the lower contracted portion of the tube (Fig. 10, *c a*), and is protected from the rain by the arched upper lip and by a thick rim of hairs. Above the narrower lower portion the tube expands and throws out a broad lip (Fig. 10, *m*), which serves as an alighting place for large bees, while the length of the narrow tube prevents the smaller species from obtaining access to the honey, which would be injurious to the flower, as it would remove the source of attraction for the bees, without effecting the object in view. At the base of the tube, moreover, there is a ring of hairs, which prevent small insects from creeping down the tube and so getting at the honey. Lamium, in fact, like so many of our other wild flowers, is especially adapted for humble-bees. They alight on the lower lip (Fig. 10, *m*), which projects at the side so as to afford them a leverage by means of which they may press the proboscis down the tube to the honey; while on the other hand the arched upper lip, in its size, form, and position, is admirably adapted not only as a protection against rain, but also to prevent the anthers (Fig. 10, *a a*) and pistil (Fig. 10, *s t*) from yielding too easily to the pressure of the insect, and thus to ensure that it presses the pollen which it has brought from other flowers against the pistil.

The stamens do not form a ring round the pistil, as is so usual. On the contrary, one stamen is absent or rudimentary, while the other four lie along the outer arch of the flower, on each side of the pistil. They are not of equal length, as is usual, but one pair is shorter than the other; sometimes the inner pair, and at others the outer pair being the longest. Now, why is this? Probably, as Dr. Ogle has suggested, because if the anthers had lain side by side, the pollen would have adhered to parts of the bee's head which do not come in contact with the stigma, and would therefore have been wasted; perhaps also partly, as he suggests, because it would have been deposited on the eyes of the bees, and might have so greatly inconvenienced them as to deter them from visiting the flower. Dr. Ogle's opinion is strengthened by the fact that there are some species, as for instance the Foxglove, in which the anthers are transverse when immature, but become longitudinal as they ripen.

But to return to the Dead Nettle. From the position of the pistil which hangs down below the anthers, the bee comes in contact with the former before touching the latter, and consequently generally deposits upon the stigma pollen from another flower. The small processes (Fig. 10, *m*) on each side of the lower lip are the rudiments of the lateral leaves with which the ancestors of the Lamium were provided. Thus, then, we see how every part of this flower, is either, like the size and shape of the arched upper lip, the relative position of the pistil and anthers, the length and narrowness of the tube, the size and position of the lower lip, the ring of hairs and the honey, adapted to ensure the transference, by bees, of pollen from one flower to another; or, like the minute lateral points, is an inheritance from more highly developed organs of ancestors. If we compare Lamium with other flowers we shall see how great a saving is effected by this beautiful adaptation. The stamens are reduced to four, the stigma almost to a point; how great a contrast with the pines and their clouds of pollen; or even with such a flower as the Nymphæa, where the visits of insects are secured, but the transference of the pollen to the stigma is, so to say, accidental. Yet the fertilisation of Lamium is not less effectually secured than in either of these.

In this flower it would appear, as already mentioned, that the pistil matures as early as the stamens, and that cross-fertilisation is obtained by the relative position of the stigma, which, as will be seen in the figure, hangs down below the stamens, so that a bee bearing pollen on its back from a previous visit to another flower would touch the pistil and transfer to it some of this pollen before coming in contact with the stamens.

In other species belonging to the same great group (Labiatæ) the same object is secured by the fact that the stamens come to maturity before the pistils have shed their pollen, and shrivelled up before the stigma is mature.

Fig. 11 represents a young flower of *Salvia officinalis* * in which the stamens (*a*) are mature, but not the pistil (*p*), which moreover from its position is untouched by bees visiting the flower. The anthers as they shed their pollen gradually shrivel up; while on the other hand the pistil increases in length and curves downwards, until it assumes such a position that it must come in contact with any bee visiting the flower, and would touch just that part of the back on which pollen would be deposited by a younger flower. In this manner self-fertilisation is effectually provided against. There are, however, several other points in which *S. officinalis* differs greatly from the species last described.

The general form of the flower indeed is very similar. We find again, as generally in the Labiates, the corolla has the lower lip adapted as an alighting board for insects, while the arched upper lip covers and protects the stamens and pistils.

In the present species, however, the back of the upper lip shows a deep arch at the part *x*, and the front portion of the lip, containing the stamens, is loftier than in Lamium, and does not therefore come in contact with the back of the bee. In evident correlation with this arrangement we find a very remarkable difference in the stamens (Figs. 13 and 14). Two of the stamens are minute and rudimentary. In the other pair the two anther cells (Fig. 14, *a a*), instead of being as usual close together, are separated by a long connection. Moreover, the lower anther cell contains very little pollen, sometimes indeed none at all. This portion of the stamen, as shown in Fig. 13, hangs down and partially stops up the mouth of the corolla tube. When, however, a bee thrusts its head into the tube in search of the honey, this part of the stamen is pushed into the arch, the connectives of the two large stamens revolve on their axis, and consequently the fertile anther cells are brought down on to the back of the bee, as shown in Fig. 12.

(*To be continued.*)

NOTES

THE German Government has determined upon the erection of a Sun Observatory ("*Sonnen-Warte*") upon a large scale at Potsdam. Drs. Spoerer and Vogel have already been appointed to undertake the telescopic and spectroscopic observations, and the directorship has been offered to Prof. Kirchhoff, who, however, has declined it, as he is unwilling to leave Heidelberg.

THE International Congress of Orientalists was opened in London on Monday, by an address from Dr. Birch. We hope to give an account of the proceedings in our next number.

WE are glad to see that a contemporary not specially devoted to science—the *Morning Post*—in an article on Dr. Hooker's address at Belfast, points out to its readers that the majority of the observations referred to could be made "by any intelligent person without any scientific training," and expresses a hope that "people who have the opportunities for cultivating, and leisure for observing, will make collections of plants . . . . and add to our stock of knowledge." At the same time it suggested these as interesting subjects for observation:—"How much can plants eat in twenty-four hours? When do they eat most? Under what conditions of weather? &c. Indeed, the whole field is one that is almost unexplored." May this hint, which will reach many who are not readers of scientific papers, not be without result! We would draw attention to the fact that plants of *Drosera rotundifolia* are advertised for sale at ninepence each, and we hope that before long some enterprising dealer may make a speciality of all known carnivorous plants for suitable observations.

---

* The *Popular Science Review* for July 1869 contains a very clear and interesting paper by Dr. Ogle on this genus.

AT the Botanic Garden, Oxford, the Mexican *Dasylirion acrotrichum* recently threw-up a flower stem which, when 12 ft. high, grew at the rate of six inches in twenty-four hours. The *Nelumbium luteum* (the sacred bean) is reported this season as producing perfect seeds.

AN *Annuaire de l'Horticulture Belge* is announced as soon to appear.

THE last number of the *Gardener's Chronicle* gives a drawing of four lopped elms growing near Datchet, the tops of which have naturally grown with the outline of a horse.

THE Academy of Sciences in Copenhagen announces the subject for a prize essay, to be addressed to it through its secretary by the end of October 1875. It desires a memoir that shall collect in chronological order the various determinations of constant quantities that have been used in spherical and theoretical astronomy from the time of the Ptolemies down to the end of the eighteenth century. It will not be necessary to submit to any critical discussion the intrinsic value of the various constants, but simply to give them in as complete a manner as possible. Special researches respecting the proper motions of stars and parallaxes of stars will be excluded, as also will be those relating to the satellites of the exterior planets, and the elements of orbits of comets. It is desired principally to obtain a complete collection of those numbers that have served as the basis of earlier astronomical researches. The memoir may be written in either Latin, French, German, Swedish, or English; and the medal to be awarded will be of gold, of the value of 320 Danish crowns.

PROF. SILVESTRI reports that a transversal fissure about a mile long has appeared on the northern side of Mount Etna. Twenty fresh craters situated upon one long line have been thrown up. The first crater opened forms a cone 75 ft. high. Prof. Silvestri believes that the force of the eruption is at present spent, and that only a few slight earthquake shocks will now be felt.

M. N. RAUÏS, Assistant Secretary of the Belgian Royal Academy of Sciences (Brussels), proposes to publish a work having for its title "Dictionnaire universel des académies, sociétés savantes, observatoires, universités, musées, archives, bibliothèques, jardins botaniques," &c.,—a methodical catalogue of all establishments which contribute to the progress of science, letters, and the arts. M. Rauis, to enable him to carry out his praiseworthy scheme, requests the managing officials of institutions of the kind indicated to furnish him with the needful information in the form indicated by the following questions:—1. Title of the establishment. 2. Date of foundation, creation, &c. 3. Its aim. 4. Titles of the directorate. 5. Seat of the Institution, with its exact address. 6. Meetings, prizes, &c. 7. Does the establishment possess a library, archives, museum, cabinet of medals or antiquities, observatories, laboratories? 8. Publications:—Number and nature (bulletin, reviews, annals or memoirs); number of volumes published from the commencement; the easiest way of procuring these publications, whether by purchase or exchange. 9. All other useful information not comprised in the preceding questions. We hope all our British scientific institutions, societies, and clubs, will aid M. Rauis in his important undertaking.

AN exhibition of photographs, &c., in connection with the Photographic Society will be opened on October 13, at the Suffolk Street Gallery. Specimens will be received up to October 7. We have on former occasions pointed out that photography has a scientific as well as a purely artistic interest, and the present opportunity should not be allowed to pass without illustrations of what photography has done to advance pure science. Mr. John Spiller, F.C.S., has been elected President, and Mr. R. J. Friswell, F.C.S., Hon. Sec. of the Society, so that the interest of science will have a good chance of being in future attended to.

WE have received the prospectus of the Owens College School of Medicine for Session 1874–5, the professorate of which has recently been completed by the appointment of Dr. M. Watson to the chair of Anatomy. The new buildings will be opened by Prof. Huxley, F.R.S., on Friday, Oct. 2, at 3 P.M.

THE Exhibition of useful and noxious insects in Paris, which we announced (vol. x. p. 295), was opened last week in the Tuileries Gardens, and promises to be highly interesting and useful.

PROF. VON RATH, of Bonn, in *Poggendorff*, describes under the name *Foresite* a new mineral of the Zeolite family, from the granite of Elba. It is named in honour of its discoverer, Sig. Foresi, of Portoferrajo, in Elba, who found it in druses which were covered with felspar, oligoclase, quartz, lithia, and tourmaline, on which, along with Desmin [stilbite] and Stilbite [Heulandite] it forms incrustations. Foresite belongs to the prismatic system; has a similar appearance to Desmin, with surfaces bright as mother-of-pearl. The angular measurements, like the faces, indicate that it is isomorphous with Desmin. Its water, which amounts to 15·31 per cent., is entirely driven off at a red heat under the blowpipe. It decomposes with difficulty in hydrochloric acid, and its silica does not gelatinise. A mean of three analyses shows it to consist of—

Silica	49·96
Alumina	27·40
Lime . . .	5·47
Magnesia	·40
Potash .	·77
Soda	1·38
Water	15·07
	100·45

Von Rath regards its chemical formula as—

$$Na_2O,\ 3CaO,\ 8Al_2O_3,\ 24SiO_2,\ 24H_2O,$$

and thus it makes a further approximation to Desmin. It differs from all known Zeolites in the small proportion of lime to alumina and silica.

AN International Exhibition is to be opened at Chili on Sept. 16, 1875.

THERE has been started at Mevagissey, Cornwall, a manufactory of "Cornish sardines," the sardines being pilchards preserved in oil, immense quantities of which have hitherto been used as manure, or returned to the sea as of no use. We believe these Cornish sardines are at least equal to the sardines commonly imported into this country.

THE *Times* Alexandria correspondent, under date Sept. 6, states that Mr. H. M. Stanley passed through Egypt a few days previously on his way to Zanzibar. An ingeniously constructed boat, built for Mr. Stanley's expedition, was recently tried on the Thames.

WE have received the programme of the many-sided Birmingham and Midland Institute for 1874–75. Sir John Lubbock, Bart., F.R.S., delivers the inaugural address on Nov. 5, and among the other special lectures announced are two on "Cor l

"Animals and Coral Islands," by Prof. W. C. Williamson, F.R.S.; "Assyrian Mythology," by Mr. George Smith; two on "The Education of the People," by Prof. W. K. Clifford; "Vitality in Men and in Races," by Dr. B. W. Richardson, F.R.S.; "A Night at Lord Rosse's Telescope," and "The Pendulum," by Prof. Ball, F.R.S.

THE following candidates have been successful in obtaining Royal Exhibitions of 50*l.* per annum, each for three years, and free admission to the course of instruction at the following institutions:—(1) To the Royal School of Mines, Jermyn Street, London: Charles W. Folkard, Lawrence J. Whalley, Alfred N. Pearson. (2) To the Royal College of Science, Dublin: Thomas Bayley, William Fream, Archibald N. McAlpine.

MR. RAMSAY WRIGHT, M.A., B.Sc., Assistant to the Professor of Natural History, Edinburgh University, has been appointed to the Chair of Natural History, University College, Toronto. Mr. Wright succeeds Prof. Alleyne Nicholson, now of the Newcastle College of Science.

PROF. E. S. HOLDEN, U.S. Navy, forwards us a letter from Mr. H. G. Wright, dated San Bernardino, Cal., Aug. 2, 1874, describing a small lake or pond in New Hampshire having two outlets, and with which he has been perfectly familiar from boyhood. "Neither of the outlets," the writer states, "ever dries up, and each of them discharges more water than enters through the only visible feeder. The pond covers, say, fifteen acres; it is shallow, with muddy bottom, with boulders in places, the surrounding land being largely made up of granite ledges and boulders. The outlets are at opposite ends of the pond—one descending rapidly 150 feet soon after leaving the pond, the other passing through a boggy swamp and then a meadow, after which it also descends rapidly. The only feeder is very small, and quite dries up in summer."

UNDER the title of "Society for the Publication of Tracts relating to the History and the Geography of the Latin East," an association has been formed in France to supplement the work of the Academy of Inscriptions. Notwithstanding the labours of the latter body, there still exists in the public depositories of various European countries, a large mass of unedited materials relating to the "Latin East,"—the kingdoms of Jerusalem, Cyprus, and Armenia, the principalities of Antioch and Achaia, and the Latin Empire of Constantinople. It is for the purpose of unearthing and publishing such material that the French society has been formed. It will be composed of forty titular members and 350 subscribing associates; from among the former a committee of publication will be selected, and the members of both classes may be either French or foreign. Two volumes will be published annually, along with a phototypographic reproduction of very rare or unique matter; to the latter titular members alone are entitled. The collection will be entitled "Bibliothèque de l'Orient Latin," and will consist of a Historic Series, a Geographical Series, and a Poetical Series. They will be published after the style of the "Chronicles and Memorials of Great Britain." Titular members pay fifty francs a year, and subscribers only fifteen.

THE additions to the Zoological Society's Gardens during the past week include a Serval (*Felis serval*) from West Africa, presented by Mr. Spencer Shield; a Cinereous Sea Eagle (*Haliaetus albicilla*) from Norway, presented by Mr. W. J. Sadler; two Peregrine Falcons (*Falco peregrinus*) from Europe, presented by Mr. Herbert Wood; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. P. T. Wharton; a Crested Pigeon (*Ocyphaps lophotes*), two Graceful Ground Doves (*Geopelia cuneata*), hatched in the Gardens; two Green Fruit Pigeons (*Carpophaga sylvatica*) deposited.

NOTES ON THE NEW EDITION OF MR. DARWIN'S WORK ON THE STRUCTURE AND DISTRIBUTION OF CORAL REEFS (1874.)

MR. DARWIN, in the new and much improved edition of his work on Coral Reefs, mentions some points in the subject, on which he still finds reason to differ from the writer. I think that with regard to one or two of these points he has not fully understood my views; and, as to the others, that the arguments and facts which I have brought out have not received all the consideration they may deserve. A review of some statements in his work may, therefore, be profitable. I follow the order of his criticisms as briefly stated in the first half of his Preface.

I. The second sentence of the Preface is as follows:—

"In this work [Dana's Corals and Coral Reefs] he [the author] justly says that I have not laid sufficient weight on the mean temperature of the sea in determining the distribution of coral reefs; but neither a low temperature nor the presence of mud-banks accounts, as it appears to me, for the absence of coral reefs throughout certain areas; and we must look to some more recondite cause."

The first two clauses of this sentence are true—the *but* between them being removed, as it may lead some readers to suppose the alternative mine. Yet Mr. Darwin's work does not show that even now he appreciates the influence of oceanic temperature on the distribution of coral reefs. In his discussions on the distribution of reefs, and the causes limiting the same, this agency, the chiefest with marine life, both for depth and surface, according to all zoologists, is scarcely mentioned. There is one allusion to the subject on page 81. Mr. Darwin says: "I at first attributed this absence of reefs on the coasts of Peru and of the Galapagos Islands to the coldness of the currents from the south, but the Gulf of Panama is one of the hottest pelagic districts in the world;" and a note is added, giving some sea temperatures of the region referred to. Thus the cause is set aside even for the seas along the Peruvian coast, although the mean winter temperature of the water there is lower than exists in any reef region in the world, and is therefore sufficient of itself to exclude reefs. The fact that there are only small patches at Panama, where the temperature is tropical, does not annul the fact that the seas of Peru and the Galapagos are too cold for corals. Where temperature excludes, there is no use in discussing other unfavourable conditions.

The causes limiting the growth and distribution of reef-making corals and coral reefs, which I have discussed and applied in my work, are *seven* in number:—

(1.) Marine temperature.

(2.) Fresh and impure waters from the entrance of large rivers and muddy bottoms.

(3.) Deposition of sediment borne by rapid tidal currents.

(4.) The depth of water along coasts exceeding 100 feet, that is, exceeding the depth to which reef-corals may grow—a common condition along bold coasts, and often explaining, as I have found, the contrasts between the reef-bordered and open coasts of the same island.

(5.) Exposure to the heat of submarine volcanic eruptions (pp. 299, 317).

(6.) The progressing coral island subsidence too rapid for the polyps to keep the reef well at the surface, if at all (p. 270): which cause may lead, in atoll seas, to very narrow fringing reefs; to small sizes in coral atolls, and a more or less complete obliteration of the lagoon; and to a submerging of the coral island beneath the surface; or finally, to a complete disappearance of the island (pp. 332, 369).

(7.) The direction and temperature of oceanic currents (p. 112): this cause accounting for the non-distribution of Central Pacific species of corals to the Panama coast, and the paucity of species there, with the absence of the large Astræa group and the Madrepores.

On this last point I say in explanation, on page 112: "Owing to the cold oceanic currents of the eastern border of the Pacific—one of which, that up the South American coast, is so strong and chilling as to push the southern isocryme [the line passing through points of equal mean oceanic temperature for the coldest month of the year] of 68°, the coral sea boundary, even beyond the Galapagos, and north of the equator—the coral-reef sea, just east of Panama, is narrowed to 20°, which is 36° less of width than it has in mid-ocean; and this suggests that these currents, by their temperature, as well as by *their usual westward direction*, have proved an obstacle to the transfer of mid-ocean species to the Panama coast." For the same reason the transfer of corals—warm-water species—from the West Indies or the Bermudas, eastward, to *Western Africa*, is impossible. The width of the coral reef region on the African side of the Atlantic is only 15°, while it is 48° toward the American coast, and the tropical current is *eastward*.

A proper understanding of the action of the various causes influencing the growth and distribution of polyps and reefs, which have been mentioned in the preceding paragraphs, may leave much less than has been imagined for that "more recondite cause."

I did not think to include among the causes a too rapid *upward* change of level—on which Mr. Darwin lays much stress. But I recognised the fact that when a rise, like that which has occurred at the island of Oahu [putting an extended range of reef thirty feet out of water] takes place, and so divides the area of reef into an elevated and non-elevated portion, the latter will be, on this account, narrower than it would have been had the land been stationary. But the cause does not appear to me to have very many examples.

II. The third sentence of the Preface reads thus:—

"Professor Dana also insists that volcanic action prevents the growth of coral reefs much more effectually than I had supposed; but how the heat or poisonous exhalations from a volcano can affect the whole circumference of a large island is not clear." And this is followed by the remark: "Nor does this fact, if fully established, falsify my generalisation that volcanoes in a state of action are not found within the area of subsidence, whilst they are often present within those of elevation."

In my discussion of this subject I have attributed the destruction here referred to about islands of active, or recently active, volcanoes, not to aerial eruptions, as might be suspected from Mr. Darwin's words, but to *submarine*; and I happen to have said nothing about "exhalations." I have drawn my conclusions especially from four examples (pp. 302, 305, 306): the island of Hawaii (Sandwich Islands), about which recent eruptions, and partly submarine, have taken place on the east, south-east, south, and west slopes of the island, or through more than half of its circumference; Savaii, the largest of the Samoan or Navigator Islands, and the last of the group to become extinct, as its lava streams show; the eastern half of Maui, whose great crater must have been recently in action, while the western half bears the fullest evidence of long extinction; and the northern extremity of the Ladrones. I state that reefs often occur on favoured parts of even such volcanic islands, as they well might if submarine eruptions were the cause, and I mention examples; thus agreeing with Mr. Darwin's criticism that "the existence of reefs, though scantily developed, and, according to Dana, confined to one part of Hawaii, shows that recent volcanic action does not prevent their growth." My statement about that Hawaiian reef is worded thus: "the only spot of reef *seen* by us was a submerged patch off the southern cape of Hilo Bay." Mr Darwin cites an observation with regard to the occurrence also of reefs on the northern coast of Hawaii, which accords precisely with the principle I have laid down, since the northern part of the island is, as I state in my Geological Report of the island, that which was earliest extinct, and is oldest in all its features, and therefore that which would not have been reached by the submarine eruptions. The western peninsula of Maui, or the old part, has its coral reefs, while the eastern, or part recently active, has almost none. Savaii, in like manner, has coral reefs on its western and northern shores, while elsewhere without them.

I failed to find evidence in the case of either of these volcanic regions that they are situated within areas of elevation rather than subsidence. *Only ten miles* west of Savaii lies the large island of Upolu, having very extensive reefs—on some parts of the north side three-fourths of a mile wide; and it has not seemed safe to conclude that, while Upolu thus bears evidence of no movement or of but little subsidence, Savaii was one of elevation; or that the north and west sides of Savaii have differed in change of level from the rest of the island. In the island of Maui, having reefs on its old western half, it can hardly be that the eastern peninsula has changed its level quite independently of the western. In the near group of the Ladrones the active volcanoes are at the north end; the islands of the group are very small at that end, without coral reefs, while large at the other, and with broad reefs. One of them, Assumption Island, near which our Expedition passed, is only a small, steep, cinder cone, the vent of a submerged volcanic mountain. Such facts afford, therefore, some reason for my statement that the Ladrones appear to have undergone their greatest subsidence at the northern extremity of the range; and no observations yet made suggest the contrary view.

The general proposition, that active volcanoes are absent from areas of subsidence, appears to me to need better proof than it has received. As regards the Pacific Ocean, I have found nothing to sustain it. The subsidence of the coral island area of the ocean was one of so vast extent—the breadth 4,000 miles, according to Mr. Darwin—that the sinking could have been no obstacle to the existence and contemporaneous working of volcanoes.

III. The next point in the Preface is a right correction of a misunderstanding on my part of one of Mr. Darwin's statements.* It says: "Professor Dana apparently supposes (p. 320) that I look at fringing reefs as a proof of the recent elevation of the land, but I have expressly stated that such reefs, as a general rule, indicate that the land has either long remained at the same level, or has been recently elevated. Nevertheless, from upraised recent remains having been found in a large number of cases on coasts which are fringed by coral reefs, it appears to me that, of these two alternatives, recent elevation has been much more frequent than a stationary condition."

When my work passes to a second edition, I shall make the needed correction.

But I still hold that, while barrier reefs, as Mr. Darwin urges, are proofs of subsidence, small or fringing reefs are in themselves no certain evidence of a stationary level, and are often evidence of subsidence, even a greater subsidence than is implied by barrier reefs. I have already stated that one cause limiting distribution of reefs is bold shores, a wall of rock of even a hundred and fifty feet producing a complete exclusion. If Tahiti were to subside two thousand feet, it would be an island of precipitous shores all around, and with deep indentations, like the Marquesas, instead of one with broad shore planes. Such bold shores are evidence of subsidence; and as only very small reefs, if any, could find footing about such an island, the narrow reef would be another consequence of the subsidence, and no evidence of a stationary condition. Again, the gradual sinking of an atoll, like the Gambier group, or of a Tahiti with its barrier reefs, at a rate a little fast for the growing corals, would necessarily contract the reef region, reduce the barrier reefs of a Tahiti to narrow fringing reefs; and make an atoll, however large, a small atoll with the reef-border narrow and the lagoon perhaps obliterated. An atoll thus reduced to a sand-bank is an example of the effects of subsidence, and affords no evidence of elevation or of a long stationary condition of the region: and the same may be true of a region of narrow fringing reefs. I landed on two of the small coral islands of the equatorial Pacific which are in just the condition here described; and my book contains descriptions of others from a good observer—J. D Hague—who resided on them several months "for the purpose of studying the character and formation of the guano deposits." I found the depression of the old lagoon, in one case partly, in the other wholly, dry; and I found also that the living reefs around were narrow. Mr. Darwin inclines to regard islands of this kind as either evidence of no movement, or, of elevation. On the contrary, since the coral islands of the South Pacific diminish in size toward the region of these small islands, and since the region just beyond, to the north and north-east, is free from islands, and since all the features are such as would come to them from a continuation of the coral-island subsidence to its nearly fatal end, I believe still that I was right in considering the ocean bottom in this part to have undergone a general subsidence greater than that to the south, south-west, and west, where the atolls and barrier reefs are large.

Again, if submarine eruptions are destructive, narrow reefs may exist about volcanic islands that are undergoing a subsidence. Making a reef is slow work; and, judging from the eruptions of the present century about Hawaii, reefs would have had a poor chance in the past to form, except along the coasts that were out of reach of the submarine action.

With so many causes for the existence of narrow or fringing reefs, or of small patches of corals, it is assuredly unsafe to make them, without other corroborating testimony, evidence of a stationary condition of a region, or of an elevating movement rather than a subsiding.

IV. The next point in the Preface is stated as follows:—

---

* His article is contained in the *American Journal of Science*, 2nd series, xxxiv. 224; 1862.

"Prof. Dana further believes that many of the lagoon islands in the Paumotu or Low Archipelago and elsewhere have recently been elevated to a height of a few feet [elsewhere stated, two or three feet] although formed during a period of subsidence; but I shall endeavour to show, in the sixth chapter of the present edition, that lagoon islands which have long remained at a stationary level often present the false appearance of having been slightly elevated." And, in the body of the work, where the subject is taken up (p. 168), Mr. Darwin remarks that my belief in these small local elevations is grounded chiefly on the shells of Tridacnas embedded, in their living positions, in the coral rock at heights where they could not now survive.

The catalogue of such elevations which I give (p. 345)—after a dozen pages devoted to a discussion of the evidence respecting each—is as follows:—

Paumotu Archipelago	Honden	2 or 3
,, ,,	Clermont Tonnerre	2 or 3
,, ,,	Nairsa or Dean's	6
,, ,,	Elizabeth	80
,, ,,	Metia or Aurora	250
,, ,,	Ducie's	1 or 2?
Tahitian Group	Tahiti	0?
,, ,,	Bolabola	?
Hervey and Rurutu Groups	Atiu	12?
,, ,, ,,	Mauke	somewhat elevated.
,, ,, ,,	Mitiaro	,, ,,
,, ,, ,,	Mangaia	300
,, ,, ,,	Rurutu	150
,, ,, ,,	Remaining Islands	0?
Tongan Group	Eua	300?
,, ,,	Tongatabu	50 to 60
,, ,,	Namuka and the Hapaii	25
,, ,,	Vavau	100
Savage Island		100
Samoan or Navigator Islands		0
North of Samoa	Swain's	2 or 3
,, ,,	Fakaafo, or Bowditch	3
,, ,,	Oatafu, or Duke of York's	2 or 3
Scattered Equatorial Islands	Washington	2 or 3?
,, ,, ,,	Christmas	?
,, ,, ,,	Jarvis's	8 or 10
,, ,, ,,	Malden's	25 or 30
,, ,, ,,	Starbuck's	?
,, ,, ,,	Penrhyn's	35
,, ,, ,,	Flint's and Staver's	?
,, ,, ,,	Baker's	5 or 6
,, ,, ,,	Howland's	?
,, ,, ,,	Phoenix and McKean's	0
,, ,, ,,	Enderbury's	2 or 3?
,, ,, ,,	Newmarket	6 or 8?
,, ,, ,,	Gardner's, Hull's, Sydney, Birnie's	0?
Feejee Islands	Viti Levu and Vanua Levu, Ovalau	5 or 6?
	Eastern Islands	0?
North of Feejees	Horne, Wallis, Ellice, Depeyster	0?
Sandwich Islands	Kauai	1 or 2
,, ,,	Oahu	25 or 30
,, ,,	Molokai	300
,, ,,	Maui	12
Gilbert Islands	Taputeuea	2 or 3
,, ,,	Nonouti, Kuria, Maiana, and Tarawa	3 or more.
,, ,,	Apamama	5
,, ,,	Apaiang or Charlotte.	6 or 7
,, ,,	Marakei	3 or more.
,, ,,	Makin	?
Carolines	McAskill's	60
Ladrones	Guam	600
,,	Rota	600
Feis		90
Pelews		0?
New Hebrides, New Caledonia, Salomon Islands		none ascertained.

Of the cases of elevation here included, in *only two* are shells of Tridacnas mentioned; these are Honden Island and Clermont Tonnerre, in the Paumotus. It is not necessary to go over the evidence for the several cases, as it is stated at length in my work.

Mr. Darwin, while speaking on the subject of local elevations, on p. 176, and discussing the facts as regards the Samoan (Navigator) Islands, adds that "in another place he [Mr. Dana] says (p. 326) that some of the [Samoan] islands have probably subsided." From the remark the reader would infer that this Samoan subsidence was a local subsidence, like the elevations under consideration. But in fact my statement is in a chapter on the general coral-island subsidence, and, on the page there referred to (p. 326), I cite Mr. Darwin's conclusions as to the Gambier Island subsidence, and put with it my own from the width of the reefs of Upolu and other reef-bordered islands. At the same place I allude to the greater subsidence of Tutuila—the island next to the west, as proved by its bold shores and small reefs.

In conclusion, if I differ widely, for the reasons above stated, from Mr. Darwin, as to the limits of the areas of subsidence and elevation in the Pacific, and believe that the new edition of his work shows little appreciation of some of the most important causes that have limited the distribution of coral reefs, I have, as I say in my work, the fullest satisfaction in his theory for the origin of atoll and barrier forms of reefs, and in the array of facts of his own observation which illustrate the growth of coral formations.

JAMES D. DANA

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee on the Teaching of Physics in Schools, by Prof. G. C. Foster.

In view of the very great diversities in almost all respects of the conditions under which the work of different schools has to be carried on, the committee considered that in any suggestions or recommendations that they might make it would be impossible for them, with any advantage, to attempt to enter into details. They have therefore, in the recommendations which they have agreed upon, endeavoured to keep in view certain principles which they regard as of fundamental importance, without attempting to prescribe any particular way of carrying them out in practice.

They have assumed as a point not requiring further discussion, that the object to be attained by introducing the teaching of physics into general school-work is the mental training and discipline which pupils acquire through studying the methods whereby the conclusions of physical science have been established. They are however of opinion that the first and one of the most serious obstacles in the way of the successful teaching of the subject is the absence from the pupil's mind of a firm and clear grasp of the concrete facts and phenomena forming the basis of the reasoning processes they are called upon to study.

They therefore think it of the utmost importance that the first teaching of all branches of physics should be, as far as possible, of an experimental kind. Whenever circumstances admit of it, the experiments should be made by the pupils themselves and not merely by the teacher, and though it may not be needful for every pupil to go through every experiment, the committee think it essential that every pupil should at least make some experiments himself. For the same reasons they consider that the study of text-books should be entirely subordinate to attendance at experimental demonstrations or lectures, in order that the pupil's first impressions may be got directly from the things themselves, and not from what is said about them. They do not suppose that it is possible in elementary teaching entirely to do without the use of text-books, but they think they ought to be used for reviewing the matter of previous experimental lessons rather than in preparing for such lessons that are to follow.

With regard to the order in which the different branches of physics can be discussed with greatest advantage, considering that all explanation of physical phenomena consists in the reference of them to mechanical causes, and that therefore all reasoning about such phenomena leads directly to the discussion of mechanical principles, the committee are of opinion that it is desirable that the school teaching of physics should begin with a course of elementary mechanics, including hydrostatics and pneumatics, treated from a purely experimental point of view. The committee do not overlook the fact that very little progress can be made in theoretical mechanics without considerable familiarity with the processes of mathematics, but they believe that by making constant appeal to experimental proofs the study of mechanics may be profitably begun by boys who have acquired a fair knowledge of arithmetic, including decimals and proportion, and as much geometry as is equivalent to the first book of Euclid. They believe that it will be found sufficient to impart such further geometrical knowledge as may be required, such, for instance, as a knowledge of the properties of similar triangles—in the first instance, during the course of instruction in mechanics.

In reference to the order in which the other departments of physics should be studied, the committee do not think it possible to prescribe any one order that is necessarily preferable to others that might be adopted; but they consider it desirable that priority should be given to those branches in which the ideas encountered at the outset of the study are most easily apprehended, and illustrations of which are most frequently met with in common experience. On these grounds they suggest that the elementary parts of the science of heat may advantageously follow mechanics; that elementary optics (including the laws of reflexion and refraction, the formation of images, colour, chromatic dispersion, and the construction of the simple optical instruments) should come next, and afterwards the elements of electricity and magnetism.* When it is found possible to include in the work of a school a fuller or more advanced course of physics than that here indicated, the committee are of opinion that the discretion of the master, guided by the circumstances of the case, will best decide in what direction the extension shall take place; they suggest, however, that an early place in the course should be given to elementary astronomy, both because it furnishes the grandest and most perfect examples of the application of dynamical principles, and because it promotes an intelligent interest in phenomena which, in the most superficial aspects at least, cannot fail to arrest the attention and familiarise the mind with the wide range of application of physical laws.

The committee are strongly of opinion that no very beneficial results can be looked for from the general introduction of physics into school teaching, unless those who undertake to teach it have themselves made it the subject of serious and continued study and have also given special attention to the best methods of imparting instruction in it. They therefore suggest that with a view to affording facilities to persons desirous of becoming teachers of physics for familiarising themselves with the most efficient methods and gaining experience in them, the Council of the British Association should invite the leading teachers of physics in the universities, colleges, and schools of the United Kingdom, to allow such persons, under suitable regulation, to be present at the instructions given by them, and, when practicable, to act as temporary assistants. The committee do not hereby mean that aspirants to the teaching function should be encouraged to drop in at random to hear any lecture by any established teacher who happened to be within reach; the kind of attendance they have in view would be systematic and continued for not less than some moderate period of time, such perhaps as two or three months, agreed upon at starting.

They believe that the benefits which might result from the adoption of such a plan are very great; the advantages to those who might avail themselves of it are obvious, and while teachers of established success would have a chance of spreading widely their methods of instruction, and in fact of founding schools of discipline, the stimulus to exertion afforded by the consciousness that they were being watched by men who were preparing themselves to occupy positions similar to their own would be of the most efficient kind.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the application of Kirchhoff's Rules for Electric Circuits to the solution of a Geometrical Problem, by Prof. Clerk-Maxwell, F.R.S.

The geometrical problem is as follows:—Let it be required to arrange a system of points so that the straight lines joining them into rows and columns shall form a network such that the sum of the squares of all these joining lines shall be a minimum, the first and last points of the first and last row being any four points given in space. The network may be regarded as a kind of extensible surface, each thread of which has a tension in each segment proportioned to the length of the segment. The problem is thus expressed as a statical problem, but the direct solution would involve the consideration of a large number of unknown quantities.

This number may be greatly reduced by means of the analogy between this problem and the electrical problem of determining the currents and potentials in the case of a network of wire having square meshes, one corner of which is kept at a unit potential, while that of the other three corners is zero. This problem having been solved by Kirchhoff's method, the position of any point P in the geometrical problem with reference to the given points A B C D, is by finding the values of the potentials p_a p_b p_c p_d of the corresponding point in the electric problem when the corners a b c d respectively are those of unit potential. The position of P is then found by supposing p_a p_b p_c p_d placed at A B C D respectively, and determining P as the centre of gravity of the four masses.

On the Apparent Connection between Sun-spot and Atmospheric Ozone, by T. Moffat, M.D., F.G.S., &c.

At the last meeting of the British Association, Mr. Smith, of Birmingham, gave me a record of the number of new groups of sun-spots which appeared in each year for a number of years, and he asked me to compare the mean daily quantity of ozone in each year with the number of groups. I have done so, and in the following table I have given the mean daily quantity of ozone for nineteen years (1851-1869) with the number of groups.

Years.	Total number of new groups of spots which have appeared in each year.	Mean daily quantity of ozone	Maximum actual number of groups	Mean of ozone.
1851	141	2·6	141	2·6
1852	125	1·9	125	1·9
1853	91	2·0	202	1·5
1854	67	3·4	205	2·2
1855	28	·8	211	2·1
1856	34	·7	204	1·9
1857	92	1·1	166	2·6
1858	202	1·5	124	3·5
1859	205	2·2	130	2·0
1860	211	2·1	101	1·7
1861	204	1·9	224	1·9
			Mean, 166	Mean, 2·2
			Minimum.	Mean of ozone.
1862	166	2·6	91	2·0
1863	124	3·5	67	3·4
1864	130	2·0	28	·8
1865	93	2·4	34	·7
1866	45	1·7	98	1·1
1867	25	1·5	93	2·4
1868	101	1·7	45	1·7
1869	224	1·9	25	1·5
			Mean, 60	Mean, 1·7

It would appear from these figures that the maximum of sun-spot gives a maximum of ozone, and that the minimum of sun-spot gives the minimum of ozone. The years 1854 and 1863 appear to be exceptional. In 1854, however, ozone observations at Hawarden were suspended for three months, which may account for the irregularity in that year. There is, I think, in these results, sufficient to induce others to observe.

On the employment of Charts on Gnomonic Projection for the general purposes of Navigation, by G. J. Morrison.

The object of this paper is to recommend the adoption for the general purposes of navigation of charts on gnomonic projection, instead of on Mercator's projection, for the following reasons:—

1. The great circle course or shortest distance between any two points on the earth's surface is shown by a straight line on the chart. By means of a ruler, therefore, it is easy to find out in one moment the position of the great circle track *along the* whole course from point to point, and thus to see at a glance if there be any obstacles in the way, whereas the plotting of a great circle track on a Mercator chart involves the expenditure of a great deal of time and trouble.

2. When it is impossible to adopt the great circle course on account of obstacles in the way, it is easy, in a few moments, to lay down the best practicable course, whereas it is very difficult to do so on a Mercator chart.

---

* It should be stated that one member of the committee did not approve of the order of the subjects suggested in the text.

3. The measurement of distances on a Mercator chart is somewhat difficult, whereas on these maps distances can be measured with a transparent scale, or a pair of compasses, in a few moments.

4. The relative position of the various points on the earth's surface is more correctly shown on these maps than on those of Mercator.

The great circle course appears to be the shortest and natural route, whereas, on an ordinary chart, it appears to be much longer than the Mercator route, and seamen get a better idea from these charts of the proper route to follow than they do from a Mercator's chart.

1. It may be objected that only a small portion of the earth can be got on one sheet, and there is a difficulty in drawing a great circle course between points situated on separate sheets. This is true; but by taking some pains in arranging the maps, as has been done in this case, and by repeating portions of the earth on two or more sheets, matters have been so arranged that scarcely any voyage can be named in which the ports of arrival and departure cannot be found either on the same sheet or on opposite sheets, in either of which cases the course can be laid down instantly; and even in the rare case of two ports being found on adjacent sheets only, the course can be laid down infinitely more easily than on a Mercator chart.

2. It is impossible to find the bearing of one point from another as can be done on a Mercator chart by a compass and a parallel ruler. This really is no disadvantage; no one ought to sail along a curved course, and no one need care to know anything about such a course. If this objection be seriously urged, it only proves that Mercator's charts have put false ideas into people's heads, and that other charts are required to replace them.

SECTION C—GEOLOGY

On the discovery of Microzoa in the Chalk Flints of the North of Ireland, by Joseph Wright.

The author observed that until 1872 only one rhizopod had been found in the Cretaceous rocks of Ireland, viz., *Orbitolina concava*, recorded by Mr. R. Tate, as occurring in the greensand. In November 1872, Prof. Rupert Jones read a paper before the Geological Society of Ireland, in which he announced the discovery of nine species of Foraminifera in the chalk and chalk flints of the North of Ireland.

Mr. Wright has examined the soft powdery material which often lines cavities in the chalk flints of Ireland, and has found 69 species of Foraminifera, 11 of Ostracoda, and sponge-spicules in abundance. A full list will appear as an appendix to the next Report of the Belfast Naturalists' Field Club.

Some observations on the "paramoudras" were added. The author considers that these originated in most cases by the deposit of flint around a nucleus of sponge. A microscopic examination shows that some are charged with spicules, whilst others are nearly free from them.

Prof. H. A. Nicholson exhibited and described specimens of three new species of *Cystiphyllum* from the Corniferous limestone of Canada and Ohio. Of these, *C. Ohioense*, Nich., is distinguished by its small size, deep, pointed calice, and small number of septa; *C. squamosum*, Nich., is remarkably flattened, the calice being very shallow and oblique; *C. fructicosum*, Nich., is a compound form, composed of numerous cylindrical, straight or slightly flexuous corallites.

The next paper, by the same author, was devoted to the definition of several species from the Lower Silurian of Ohio. *Alecto inflata* of Hall was regarded as an undoubted *Hippothoa*.

Description of new species of Polyzoa from the Lower and Upper Silurian rocks of North America, by Prof. H. A. Nicholson.—In this communication the author described the following new species of Polyzoa:—1. *Ptilodictya falciformis*, Nich.; 2. *P. emacerata*, Nich.; 3. *P. flagellum*, Nich.; 4. *P. ? arctipora*, Nich.; 5. *P. fenestelliformis*, Nich.; 6. *Fenestella nervata*, Nich. 7. *Ceramopora Ohioensis*, Nich.

Prof. Nicholson also read a paper on species *Favistella*. The type of the genus *F. stellata*, Hall, he regarded as identical with Goldfuss' *Columnaria alveolata*. A new species *Favistella* (*Columnaria*) *calicina*, Nich., was described.

These papers were illustrated by numerous and beautiful examples of the species referred to.

Note on the so-called "Crag" bed of Bridlington, by J. Gwyn Jeffreys, F.R.S.

In consequence of a request made by the late Prof. Phillips, not long before his lamented death, the author examined all the known collections of fossil shells from the celebrated "Crag" beds at Bridlington, and had furnished the Professor with a *catalogue raisonné* for the new and forthcoming edition of his work on the Geology of Yorkshire. Dr. Jeffreys was lately at Bridlington with Mr. Leckenby, and ascertained that the "Crag" bed underlay the boulder-clay, and rested conformably on a bed of oolite shale of a purplish colour, which in one place appeared to have been triturated and redeposited in the form of clay. In this purplish clay they found a specimen of *Turritella erosa*, Couthouy (an arctic and North American shell), besides many other species which were common to the boulder-clay and Bridlington bed. All the species of shells found in the Bridlington bed, 64 in number, were high northern and now living. The author suggested that this deposit of shells might have been caused either by a deviation of the great arctic current in ancient times or by glacial conditions. It had clearly no relation to the Norwich Crag, as was formerly imagined to be the case.

SECTION D—BIOLOGY

DEPARTMENT OF ANATOMY AND PHYSIOLOGY

This department was not distinguished by any communication which excited such popular interest as that of Prof. Ferrier last year, but it was fully up to the average of the last few meetings in the solidity of the papers and of the discussions. The President, Prof. Redfern, opened the Section with the address printed in full in NATURE, vol. x. p. 327, which was no less admirable in style and elocution than in matter. If this was a model of a professorial lecture, the address of Dr. Hooker, also delivered before the entire Section, was equally one of a popular exposition of new and difficult scientific observations. The excellent series of illustrations and the actual specimens of the plants described, which were sent by Dr. Moore from the houses of the beautiful Botanical Gardens in Dublin, completed the interest of this admirable address.

The only report made to the department was from the committee appointed to investigate the conditions of intestinal secretion. It contained details of about sixty experiments, which confirmed, in the case of cats, Moreau's observation of the effect of division of the mesenteric nerves, showed that the secretory nerve fibres did not pass through the splanchnics, and ascertained the local effect of various neutral salts on intestinal secretion, as well as the interference of chloral, morphia, and other drugs with the local action of magnesian sulphate. The committee* was reappointed for the present year to continue these researches on the secretion and the movements of the intestines.

The most important communication on the first day was from Prof. Cleland, *On the Development of the Brain and the Morphology of the Auditory Capsule*. Beside many characteristically ingenious suggestions, the author maintained that the fourth ventricle is roofed in by nervous matter at an early period in the embryo, of which the ligula and the choroid plexus are the permanent vestiges. He also attempted to draw a parallel between the flocculus with the portio mollis and the optic lobes, tracts, and nerves. Prof. Huxley criticised these views at some length, dwelling particularly on the comparatively late development of the optic tracts, and denying that the roof of the primitive nervous canal is ever completed in the region of the bulb. A certain Goodsirian transcendentalism which appeared in Prof. Cleland's remarks has become rare among the younger school of morphologists, and probably stimulated his critic to attack what must have seemed like the revival of a thrice-slain foe; but apart from interpretations and views, there were several important observations in the paper which, it is hoped, will be given in detail with the necessary drawings.

A paper by Mr. Thomson followed, *On the Decomposition of Eggs*, in which the purely chemical changes, the penetration of bacteria, and the growth of fungi were severally described;† and Dr. Macalister exhibited a human skull with the rare abnormality of a lacrymo-jugal suture.

After the crowded audience which listened to Dr. Hooker's address on Friday had dispersed, it seemed as if the room would have been left to anatomists and physiologists; but the arrival of blacksmiths, who began to erect a large black canvas, attracted popular interest, and the visitors who flocked in were rewarded by hearing and seeing Mr. Waterhouse Hawkins discuss the true character of the so-called clavicles of Iguanodon. His account of the difficulty he experienced in building his model with these bones in the position at first assigned them by Prof. Owen, of his finally hanging them up in front of it to be fitted in after each spectator's taste, and of the shameful destruction of the results of his skill and labour at New York, was no less graphic than the illustrations with which he proceeded to cover the canvas, showing the great reptile in every posture which would consist with the disputed bones being clavicles, ossa pubis, or marsupial bones. Mr. Hawkins advocated the last as the true character; but though in the discussion which followed, some anatomists were disposed to admit this approximation of the highest of reptiles to the marsupial (or rather to the monotreme) mammals, others refused to admit any reason for rejecting the identification of the bones in dispute with the long bird-like ossa pubis of allied reptilian forms, which was made several years ago by Prof. Huxley. So at least the professor himself must have thought, for he only appeared at the conclusion of the discussion in time to hear Mr. Balfour's remarkable paper *On the Development of Sharks*. This will doubtless appear elsewhere in full. It was crowded with facts, well observed, well stated, and well illustrated; and will prove of first-rate importance, not only for ichthyology but for the general doctrines of vertebrate development. Of many new facts ascertained, perhaps the most startling is the development of the notochord by direct cellular proliferation from the hypoblast. Whether it will ultimately be found that this is its normal mode of formation among Vertebrata, or that it may be developed from different layers in different animals, the effect of this observation will be almost equally important. Those anatomists who examined the beautiful series of sections on which Mr. Balfour founded his conclusions were satisfied of the accuracy of his histological facts Prof. Huxley congratulated the author of the paper in terms of high commendation, though he inclined to believe that the apparent development from the lower embryonic layer might really be a secondary process. Mr Lankester and Dr. Foster spoke of the service rendered to biology by Dr. Dohrn's Institute at Naples, where Mr. Balfour's observations were made, an institute to the success of which the British Association had the honour to contribute.

---

* Dr. Brunton and Dr. Pye Smith.

† This paper will be found reported in the *London Medical Record* for Sept. 9.

The following paper by Prof. Redfern, *On Food in Plants and Animals*, has been well reported in the *British Medical Journal* for August 29, p. 285. It was illustrated by a striking series of specimens of plants growing on different soils, and the laws of nutrition in organised beings generally were applied with great force to the practical question of the food of the labouring classes in the north of Ireland. Well delivered, and clearly expressed, it appeared to be understood as well as applauded by a full audience.

The first paper read in the department on Monday was by Prof. Macalister, *On the Tongue of the Great Anteater*, including an account of its enormous retractile muscles and of the salivary glands. In a discussion which followed, reference was made to the original dissection of *Myrmecophaga* by Prof. Owen, and also to the observations of Mr. Flower on the same parts, of which a summary was published in the *Medical Times and Gazette* of last year.

The next paper, by Dean Byrne, was an attempt to connect the functional development of thought with the structural development of the brain, in their gradual evolution throughout the Vertebrata, as well as in their growth from the infant to the adult. Many interesting facts of animal psychology were related, and many acute comments offered, but unfortunately the works from which the author drew his facts of anatomy, pathology, and development were either antiquated or otherwise imperfect representations of the present state of knowledge on the points in question.

Though the paper which followed was also by an outsider, the Professor of Chemistry in Edinburgh has had the advantage of a medical training, and his anatomy and histology were as accurate as his physics. Nothing could be more interesting than the way in which Dr. Crum Brown described the methods he employed to ascertain the exact position of the semi-circular canals of the ear, and the experiments he made on the sense of rotation. The substance of the communication will be found in the last number of the *Journal of Anatomy and Physiology*. Notwithstanding some criticisms offered by Mr. Charles Brooke on the acoustics of the paper, both its anatomical facts and its conclusion as to the function of the canals appeared to find general acquiescence; and this research may be regarded as another proof of how rich a field lies on the border-ground between the artificial territories into which we have divided the world of science.

Before the department rose, Dr. Caton exhibited a new adaptation of a microscope on the Hartnack model, for the purpose of examining the tissues in living mammals. It was a cheaper, and, as the author believed, a more readily applicable modification of the apparatus exhibited by Professors Stricker and Sanderson, at the Edinburgh meeting of the Association.

Prof. Huxley opened the last day of session with an account of his recent observations on the development of the *Columella auris* in Amphibia. While fully confirming the position of the quadratum (or malleus) in the mandibular arch of vertebrates, and of the incus in the hyoidean, these investigations appear to show conclusively that in the amphibian, at least, the columella (or stapes) begins as an outgrowth from the periotic capsule, and is therefore unconnected with any visceral arch; although, as the speaker was careful to state, it might yet be possible that the hyoid arch had, at a very early period, left some of the tissue of its topmost extremity adherent to the ear-capsule, and that this might afterwards give rise to the stapes. In the absence of Mr. Parker there was no one competent to criticise the paper from personal knowledge; but a word dropped as to the many changes in the accepted homologies of the 'ossicula auditus, elicited a masterly and characteristic exposition of the series of new facts, and the modifications of theory they have led to, from Reichert's first observations down to the present time. The embryonic structures grew and shaped themselves on the board, and shifted their relations in accordance with the views of successive observers, until a graphic epitome of the progress of knowledge on the subject was completed.

Mr. Lankester's paper which followed was also embryological. He described his observations on the development of the eye of Cephalopoda, made like those of Mr. Balfour in the Dohrn Institute at Naples. After correcting several of the statements made in text-books on the authority of Prof. Kolliker, the author pointed out the relation of the eye in the Dibranchiata to the less specialised organ of Nautilus, and showed how the ontogenesis of this structure in the highest mollusk corresponds with its gradually increasing complexity from its first appearance in the group, thus meeting one of Mr. Mivart's objections

The session was appropriately concluded by a paper from the President, describing experiments made several years ago on the effects of ozone. The animals used were rabbits, and Prof. Redfern found them much less injuriously affected by breathing highly oxygenated air than has been supposed, while ozone in moderate amount (·4 per cent. and upwards) proved rapidly fatal, producing spasms, and death by apnœa. The lungs were found extensively emphysematous and congested, with engorgement of the right side of the heart.

Thus ended a busy and not uneventful meeting of the department. Comparing it with recent years, the room was never so crowded as it sometimes was at Bradford, nor so empty as it usually was at Brighton and Edinburgh. The most important paper last year, that of Prof. Burdon-Sanderson on the electrical changes which accompany the contraction of Dionæa, excited little popular interest, and the discussions at Edinburgh on various points of Cetacean anatomy, though carried on by Turner, Flower, Macalister, Struthers, and Murie, were caviare to the general. This year a corresponding importance may be fairly assigned to the embryological papers contributed by Prof. Huxley, Mr. Ray Lankester, Mr. Balfour, and Prof. Cleland. With a fair proportion of more popular expositions, the solid contributions which have been made during the last five or six years should attract a more constant attendance of anatomists and physiologists to this department. There were several distinguished Irish members of the Association whose presence was greatly missed at Belfast; and considering its nearness to Scotland, there was a remarkable lack of representatives *from the* northern universities. Apart from the intrinsic value of the papers read, there is so much to be gained from personal contact and discussion with men working at the same objects, that few probably feel at the conclusion of a meeting that they have not been rewarded for the sacrifice of time and convenience, and the scientific value of the Association entirely depends on its power of attracting those who are seriously engaged in the prosecution or communication of the subjects which form its several branches.

SCIENTIFIC SERIALS

Geological Magazine, September.—This number contains four original articles :—(1) The grouping of the Permian and Triassic rocks, by H. B. Woodward, F.G.S. The object is to show that the supposed break between the subdivisions of the Triassic rocks in England rests on unsatisfactory evidence; that in the Permian beds there are evidences of unconformity; and that probably future researches will lead to the resumption of the term "Poikilitic" to embrace both the Permian and Trias.—(2) On the Pleistocene deposits yielding Mammalian remains in the vicinity of Ilford, Essex, by Messrs. Woodward and Davis. This article consists partly of references to previous numbers of the magazine, the chief feature of interest in it being a letter by Mr. Searles Wood. He formerly believed the Ilford brick earths were older than the main sheet of the Thames gravel; a view which he now corrects.—(3) On the remains of *Rhinoceros leptorhinus*, Owen, from the Pleistocene of Ilford, by the editor. This is a reprint of Mr. Davis's description of the skull, as given in Sir Antonio Brady's catalogue (privately printed), together with an extract from Dr. Falconer's palæontological memoirs.—(4) On West Indian Tertiary Fossils, by R. J. Lechmere Guppy; a first instalment of descriptions which are to be continued.—Mr. J. W. Barkas, in a letter, announces that he has found a jaw of *Amphicentrum*, in sub-carboniferous limestone near Richmond, and suggests that it must have lived both in fresh and salt waters, like some modern fishes.

Astronomische Nachrichten, No. 2,005.—L. Seidel contributes a paper on the estimation of the most probable value of a number of varying observations of the same phenomenon, as the value of a number of observations of the position of a double star. There are also a quantity of position observations on Coggia's comet, by C. H. Davis, Ant. Aguilar, and Alexander Gromadzki, and the following elements of this comet are found by W. Fabritius :—

$$\begin{aligned} T &= \text{July } 8{\cdot}90006 \\ \text{Log. } q &= 9{\cdot}829699 \\ \Omega &= 118^\circ\ 44'\ 9''{\cdot}6 \\ i &= 66^\circ\ 23'\ 1''{\cdot}0 \\ \omega &= 152^\circ\ 21'\ 42''{\cdot}4 \end{aligned}$$

The opposition ephemeris of the planet Hecate (100) is contributed by Dr. J. E. Stark for each day from Sept. 17 to Oct. 27.—Prof. Spoerer sends a table of his observations on solar spots and protuberances for June. Capt. Herschel writes to ask for letters of Sir J. Herschel, stating that a collection is being made.

SOCIETIES AND ACADEMIES

Paris

Academy of Sciences, Sept. 7.—M. Frémy in the chair.—M. Resal presented the Academy with the second volume of his "Traité de Mécanique Générale," and made some remarks thereon.—M. P. Volpicelli addressed a letter to the president, stating that in 1854 Melloni had communicated a note to the Academy, entitled "Researches on Electrostatic Induction." Fifteen days afterwards the Italian physicist died of cholera at Naples, and since that time the author (M. Volpicelli) had submitted fifteen communications to the Academy on the same subject, all of which confirmed Melloni's theory of electrostatic induction. M. Volpicelli now begs the Academy to appoint a commission to report on these experiments, and expresses a hope of being permitted to repeat them before it. MM. Becquerel, Faye, Frémy, Edm. Becquerel, and Jamin were named commissioners.—Sixth note on the electric conductivity of ligneous bodies, by M. Th. du Moncel.—Presence of zircosyenite in the Canary Isles, by M. Stan. Meunier. The mineral was found in a collection made by M. Webb on the Pena Mountains.—On some laboratory experiments concerning the action of toxic gases on *Phylloxera*; actual state of the malady in the Charente provinces; extract from a letter from M. Maurice Girard to M. Dumas. The gas tried was that liberated from a sulphocarbonate. Pieces of brick saturated with the solution of the salt were placed in the bottoms of flasks; above the solution and saturated brick some strong paper was supported on which were placed phylloxerised roots. The roots thus escaped direct contact with the solution and received only the gases evolved (CS_2 and H_2S). At the end of twenty-four hours nearly all the insects were dead, with the exception of some small larvæ and some eggs; at the end of two days all the insects and the greater part of the eggs were dead; while at the end of four days complete death of the eggs took place. During the experiment the flasks were kept in the dark, and some control flasks containing phylloxerised roots only placed with the others: nearly all the insects and eggs survived in these last flasks.—On some new points in the natural history of *Phylloxera vastatrix*; a letter from M. Lichtenstein to M. Dumas. The author thus sums up the life history of the insect so far as at present known :—(1) Colonising females appearing probably in August and September; (2) small uniform progeny hybernating; (3) Oval, pyriform, testudiniform types, reproducing by parthenogenesis all the summer; (4) Pupæ of two forms, oval and narrow at the waist, specially found on the nodosities of the rootlets in June and July; (5) *Swarming* takes place in August: the insects emerge from the earth in myriads exactly as in a formicary when the winged insects escape; (6) Laying of eggs on the leaves of *Quercus coccifera*, end of August; (7) Birth of sexual apterous individuals. Copulation and production of colonising females.—On some processes for destroying *Oidium* and *Phylloxera*; extract from a letter from M. Desforges to M. Dumas.—Employment of the lime from gas purifiers to check *Phylloxera*; extract from a letter from M. L. Petit to M. Dumas.—Observation of an extraordinary passage of corpuscles across the sun; a telegram from M. Gruey, of the Toulouse Observatory, to the president. The passage took place on the 5th, 6th, and 7th of the present month.—On some applications of Abel's theorem relating to elliptic functions to curves of the second degree, by M. H. Léauté.—Note on magnetism, by M. F. M. Gaugain; a continuation of former researches.—Note on the nature of the sulphurising compound mineralising the thermal waters of the Pyrenees, by M. E. Filhol.—Note on chlorophyll, by M. E. Filhol. The chlorophyll of monocotyledons (Gramineæ, Cyperaceæ, Liliaceæ, &c.) treated with a small quantity of hydrochloric acid becomes turbid, and the solution, on filtration, leaves a black crystalline compound on the filter. This substance has been examined in some detail. It is remarkable that a solution of chlorophyll from dicotyledons yields, under the same treatment, a dark compound which is amorphous.—On some phenomena of localisation of mineral and organic substances in Mollusca, Gasteropoda, and Cephalopoda, by M. E. Heckel. Specimens of *Helix aspersa* and *Zonites algirus* were fed with white lead, or with acetate of lead mixed with wheat flour. An accumulation of metal was found in the liver and also in the cerebral ganglia. *Loligo vulgaris*, *Sepia officinalis*, and *Octopus vulgaris* were fed during two months with garancine (mixed with meat). In no case was the internal shell coloured, but the cephalic cartilage and all the cartilaginous portions of the skeleton of these Mollusca were coloured after an experiment of three months' duration. The author points out the necessity of distinguishing clearly the hard parts belonging to the skeleton from those belonging to the shell.—On the storm of the night of 1st to the 2nd of Sept. 1874, observed at Versailles; a note by M. Ad. Berigny. 17·59 mm. of rain fell during the storm, and the lightning struck four points in Versailles.

CONTENTS

PAGE
The Education of Women 395
De Boisbaudran on "Spectres Lumineux." By Prof. Andrews F.R.S. 396
Our Book Shelf 397
Letters to the Editor :—
  Pollen-grains in the Air.—Alfred W. Bennett, F.L.S. 398
  Fossils in Trap.—D. Honeyman 398
  Curious Rainbow.—R. P. A Swettenham 398
  Polarisation of the Aurora.—J. A. Fleming 398
Francis Edmund Anstie, M.D., F.R.C.P. 398
Hieroglyphic Tablets and Sculpture in Easter Island. By J. Park Harrison 399
On the Distribution of the Heat developed by Collision. By M. Tresca. 400
Subjects for Prizes proposed by the Haarlem Society of Sciences 401
Common Wild Flowers considered in Relation to Insects. By Sir John Lubbock, Bart., F R S. (*With Illustrations*) 401
Notes 406
Notes on the New Edition of Mr. Darwin's Work on the Structure and Distribution of Coral Reefs (1874) By Prof. James D Dana 408
The British Association. Reports and Proceedings 410
Scientific Serials 414
Societies and Academies 414

Erratum.—P. 379, col. 2, line 8 from bottom, for *or* read *on*.

THURSDAY, SEPTEMBER 24, 1874

THE MIGRATION OF BIRDS

THE "silly season" has this year been marked by some discussion in the newspapers on the migration of birds. The various letters published have shown the normal want, if not of knowledge, yet of profundity; and I fear lest the subject, which really deserves the best attention from naturalists, should suffer in repute by the absurdities lavished upon it.

The discussion began, if I am not mistaken, with a theory of migration set forth by a Scandinavian poet, which treated that wonderful movement as an attempt on the part of birds to attain "more light." It proceeded on the hypothesis that the birds which are summer-visitors to northern climes, finding that the days grow shorter as summer advances, retire southwards to find "more light," and that the same desire prompts their return northwards in spring. To show the fallacy of this hypothesis it is sufficient to observe that the southward movement not only begins, but is with many species in great part accomplished, long before the autumnal equinox, when consequently the birds are journeying to increasingly shorter days; and in like manner their northward movement is set on foot before the vernal equinox, with of course the same result. Whether this theory was ever intended in earnest or was only a poetic fancy I do not know, nor is it really worth while to inquire. It is enough that it contains its own refutation.

I have no intention of commenting upon the whole discussion. Few, if any, of the letters which followed contain anything to the purpose either way. But one published in the *Times* of Friday, Sept. 18, seems to require special notice, since it professes to give "the latest accepted theory" on the subject; and the writer, without actually saying that it is received by a very great authority, whom he names, intimates that it does not meet with his disapproval. Of this "latest accepted theory" I must confess I never before heard; and now that it is before me, it seems to be not only unsupported by facts, but to amount to no explanation at all. After briefly touching upon the difficulty which the shorter-winged Birds of Passage must have in effecting their voyages, the writer says:—

> "I believe it was only some twenty or thirty years ago that anything like a practical solution of the difficulty was arrived at. The birds congregating about the south coast are seized with a sudden impulse or mania to fly upwards. This is caused by some atmospheric change coinciding with a warm south wind moving in a high stratum, into which the birds soar with an involuntary motion of their wings. This motion (involuntary like that of the heart) is continued for many hours, and the birds fly blindly along until the paroxysm passes off, when they at once begin to descend, making many a fatal drop into the sea.
>
> "The same phenomenon occurs in Africa and southern countries, where the migratory birds congregate for a northern flight about April. Experiments were tried here and in Africa which tended to corroborate the above facts. Migratory birds were kept in cages along the coast, and it was found that each was seized with a prolonged paroxysm coinciding with the time that the wild birds disappeared. Cages were constructed with silk at top and bottom to prevent the birds from killing themselves; and it was noticed that after the paroxysm had passed away, the birds began to look about them, to plume themselves, and eat and drink, apparently with a notion that they had arrived at their new home."

On reading these wonderful paragraphs, some questions naturally arise. How does the writer account for his "birds congregating about the south coast?" What brings them there, that they may be "seized with a sudden impulse or mania to fly upwards?" Who has ever observed the "atmospheric change" and coincident "warm south wind moving in a high stratum?" Do these remarkable meteorological phenomena occur but once in the whole season of migration, or is there a succession of them to suit the convenience of each migratory species? Who, moreover, has seen the birds soar into this peculiar current of air? and who of such fortunate persons knows that the motion of their wings under such conditions is "involuntary like that of the heart?" Finally, what is the cause of the "paroxysm"? for, without knowing that, to attempt to explain the observed facts of migration is an attempt to explain *obscurum per obscurius*.

When a satisfactory answer is given to these questions, it will be time to inquire whether this "latest accepted theory" of migration sets the matter in any clearer light, or whether it is not as arrant nonsense as was ever foisted upon an innocent public, even at the height of the "silly season." The last paragraph of the writer's letter, I may remark, has nothing in it of consequence. Granting that the migratory impulse is instinctive, it is, like other instinctive practices, followed as far as circumstances will allow.

Permit me now to point out to those interested in the solution of this mystery of mysteries the chief matters to which the attention of observers and theorisers should be directed.

I. *The original Cause or Causes of Migration.*—In some cases scarcity of food would seem to be a sufficient cause, and it is undoubtedly the most obvious one that presents itself to our mind. As food grows scarce towards the end of summer in the most northern limits of the range of a species, the individuals affected thereby seek it in other countries. Thus doing, they press upon the haunt of other individuals; these in like manner upon that of yet others, and so on, until the movement which began in the far north is communicated to the individuals occupying the extreme southern range of the species at that season; though, but for such an invasion, these last might be content to stay some time longer in the enjoyment of their existing quarters. When we consider, however, the return movement, at the end of winter, it is doubtful, I think, whether scarcity of food can be assigned as its sole or sufficient cause. But here we feel the want of knowledge. At present we are far too little acquainted with the physical peculiarities of those more equatorial regions, which in winter are crowded with emigrants from the north, to come to any final decision. It seems not too violent an assumption to suppose that though such regions are well fitted for the winter resort of the bird-population of the north, they may be deficient in certain necessaries for the nursery; and it seems still less of an assumption to suppose that even if such necessaries are not wanting, yet that the regions in question would not supply food sufficient for both parents and offspring—the latter being, at the lowest computation, twice as numerous as the former—unless the numbers of both were diminished by the casualties of travel. But another point must not be overlooked. The most sedentary of birds year after year occupy the same quarters in the breeding season. In some instances this may be ascribed, it is true, to the old haunt affording the sole or the most convenient site for the nest in the neighbourhood, but in so many instances such is not the case, that we are led to believe in the existence of a real partiality, while there are quite enough exceptions to show that a choice is exercised. The same may equally be said of the most migrant of birds, and perhaps the strongest instance that has ever come to my knowledge refers to one of the latter. A pair of Stone Curlews (*Œdicnemus crepitans*)—a very migratory species, affecting almost exclusively the most open country—were in the habit of resorting for many years to the same spot, though its character was entirely changed. It had been part of an extensive rabbit warren, and was become the centre of a large and flourishing plantation. It seems to me, therefore, that among the causes of migration the desire of returning to old haunts must be included.

II. *The Mode or Modes of Migration.*—This heading is capable of much subdivision. The means of transition are of course found in the bird's wings, but do all birds migrate in the same manner? Nay, more, does the same species of bird migrate in the same manner at all times? And how is its return to the old haunt accomplished with a degree of certainty that in most cases may be called unerring?

That all birds do not migrate in the same manner is pretty plain. Some, as the swallows, conspicuously congregate in vast flocks, and so leave our shores in a large company, while the majority of our summer visitors slip away almost unobserved, each apparently without concert with others.

It is also pretty nearly certain that the same species of bird does not migrate in the same manner at all times. Mr. St. John tells us of the arrival of skylarks on the coast of Norway:—"They come flitting over in a constant straggling stream, not in compact flocks." Yet it is notorious that a little later these same birds collect in enormous flocks, which prosecute their voyage in company. As tending to the same conclusion, I need hardly do more than refer to the excellent observations of Mr. Knox on the movements of the Pied Wagtail ("Ornithological Rambles," third edition, pp. 81–86) and, indeed, to the whole of his remarks on migration, because they must or ought to be known to everyone who takes an interest in the subject. But more than this, it is pretty nearly certain that of the majority of northward migrants in spring the males take the lead, and anticipate the advent of their mates by some days, not to say weeks—a fact which may possibly indicate the existence of another cause of migration to which I have not before alluded—while this peculiarity has never been observed in the autumnal movement.

Then comes the question, How is it that birds find their way back to their old home? This seems to me the most inexplicable part of the whole matter. I cannot even offer an approach to its solution. There was a time when I had hopes that what is called the "homing" faculty in pigeons might furnish a clue, but my good friend Mr. Tegetmeier has cruelly deprived me of that consolation, declaring that knowledge of landmarks obtained by sight, and sight only, is the sense which directs these birds, with which he is so conversant; while sight alone can hardly be regarded as much of an aid to birds —and there is some reason to think that there are several such—which at one stretch transport themselves across the breadth of Europe. Here I have no theory to advance, no prejudice to sustain. I should be thankful indeed for any hypothesis that would be in accordance with observed facts. They leave no room for chance and not much for counteracting forces. Occasionally the return of the nightingale, the swallow, or other land birds, may be somewhat delayed, but most sea-fowl can be trusted as the almanack itself. Were they satellites revolving around this earth, their arrival could not be more surely calculated by an astronomer. Foul weather or fair, heat or cold, the puffins repair to some of their stations as regularly on a given day as if their movements were timed by clock-work. Whether they have come from far or from near we know not, but other birds certainly come from a great distance, and yet they make their appearance with scarcely less exactness. Nor is the regularity with which certain species disappear much inferior; every observer knows how abundant the swift is up to the time of its leaving its summer home, and how rarely it is seen after that time is past. Yet all this, marvellous as it may seem, is far less marvellous than the instinct, or whatever else we may call it, which guides the birds in their voyages, and gives them the power of directing their flight year after year to the same spot. The solution is probably simple in the extreme—possibly before our eyes at this moment if we could but see it—but whosoever discovers it will assuredly deserve to have his name remembered among those of the greatest discoverers of this or any age.

Alfred Newton

COMPETITIVE EXAMINATIONS

In so universally substituting Competitive Examination for the much less perfect systems of patronage and favouritism previously adopted for filling appointments and distributing emoluments, no doubt the step has been in the right direction; but as with all novel systems, the necessary details of its working have not been fully mastered, and we have complaints,—such as from many who have no other recommendations upon which to make selections in scientific appointment, and from the India Civil Service,—that the results are not, in the long run, so successful as could be wished. Many of the objections which were at the outset thought to be insurmountable, have been proved to be insignificant and remediable; whilst others, unforeseen and more difficult to overcome, are daily becoming more and more conspicuous.

The most important of these objections depends on the fact that it is impossible, from the list of successful candidates, even when they are classed according to the number of marks they have obtained, to determine whether they belong to the one or the other of two very different qualities of mind. There are certain students whose chief capacity consists of a very excellent memory in combination with a power of discriminating what is, and what is not, important in an examination point of view. These, in the hands of an experienced teacher, an able "crammer," or with well-selected books at their disposal, are able, by dint of hard work, so far to make up for their own deficiency in originating power, as to appear, in an examination conducted on ordinary methods, indistinguishable from those who, by accurate observation and much less reading than themselves, have from their superior capacity been able to obtain the same amount of information. What is the result? Taking an instance in which one of each of these classes competes, one against the other, perhaps the former has come out senior and the latter second in the examination list. The latter knows that he might have done better without much effort, and is in no way injured by being beaten. But the former is in a very different position. He finds himself placed above a man of acknowledged great ability, and from this in his smaller mind he infers that he is greater still, considering that he has beaten all. He goes forth into the world with a conscious and unfounded feeling of power; sets up for being a genius; and though his capacities may be anything but inconsiderable, he completely over-estimates himself. If he is a man who has to get his living entirely by his own work he most probably attempts the highest things; to become a barrister or a physician rather than to follow the routine of a solicitor or a general practitioner, for which in reality he is more suited. When the struggle for life commences in earnest he has the continual mortification of seeing others, to whom he has been led by his examination results to think himself superior, passing him on account of their greater ability. This sours his disposition, depresses him unwarrantably, compels him ultimately to relinquish his higher aspirations, and, as a despondent cynic, makes him take to the more humble line of action which at the time of his success he despised so thoroughly.

This is not an overdrawn picture, its counterpart may be seen on all sides, and many more like it will be forthcoming if some radical change is not made in the method of examination now in vogue. What that change must be deserves the serious consideration of all interested in the progress of every branch of social economy, as well as of those who have the responsibility of filling posts of scientific importance. In this respect we think that the older Universities, Oxford and Cambridge, in their more venerable honour examinations, set by far the best example. How accurately, in many of the colleges, the exact mental capacities of those of its undergraduates who are candidates for honours are known, is also more than surprising to the uninitiated. The reason of this is that the examiners are men of acknowledged ability, and what is as much to the point, they have themselves gone through the same training, with the same objects in view, as those whom they are comparing. The ultimate object of work has no doubt a very important bearing on the manner in which it is undertaken; and it is hardly to be wondered at that in a competition like that for the India Civil Service, in which so painfully large a number of subjects is frequently included by some of the candidates, specialist examiners find it extremely difficult to judge, from the undigested mass of answers they have to compare, which is the least bad of the candidates before them. In institutions like the University of London, the system of offering scholarships to be competed for in special "honours" examinations, which follow those for simply obtaining the degree, has, in many cases we could refer to, had the same injurious effect of giving men a false estimate of their own practical power of getting on in life; and whether in the long run the older method of conferring degrees after a pass examination only, without any associated pecuniary reward, is not the best is still a subject quite *sub judice*. In Medical Science this is particularly the case, for in it, more than or as much as in any other, a purely theoretical knowledge of any department of Chemistry, Physics, or Biology, is but of slight value in comparison with the experience of the bed-side, when the commencing practitioner is called upon to diagnose and prescribe without any assistance from others.

In the Universities of Oxford and of Cambridge we have an opportunity of watching the working of the two different systems of examining competing candidates. In the former the lists appear with the names in each arranged alphabetically in three or four classes, and not according to the actual merit in each class. The public are therefore told by this method the average standard to which a man has risen, and no more; for the rest they are left to judge by other entirely independent and perfectly voluntary performances by which he has the opportunity of exhibiting the quality of his ability. In Cambridge the tripos lists place each man in exactly his place with regard to the other men of his year who have taken up the same subject as himself, and every attempt is made to maintain all the triposes at such a standard that corresponding classes indicate similar ability. From the remarks with which we commenced it is evident that the Oxford system has many advantages; and that the other is liable to lead to the injurious result we have mentioned, which in that particular case it does not, on account of the antiquity of the system and the extremely careful way in which the examinations are conducted.

It is the fashion in most modern examinations to include a large number of subjects, many of which may be taken up by each candidate. This, no doubt, is a mistake in many instances. It is not so much information that is wanted in a young man—that will come when the stimulus for showing it becomes greater, but the exhibition of mental capacity; and with examiners of any worth, who have had any experience, it is not at all difficult to estimate the powers of candidates from a very few answers in a very few subjects, especially if any *vivâ voce* and practical questions are included.

A competitive examination should therefore have for its object the estimation of the power of the candidate, and that only. It should be so conducted as to place him on a standard table in such a position that if it were possible from a physical examination of his brain to judge of his brain capacity, the results of the two methods would coincide. This can be best attained by restricting the examination to a few subjects; by asking questions which call for method in their answers rather than fact; and by having able examiners who are acquainted with future work to be expected of the candidate. Candidates thus selected in the long run must certainly be found more satisfactory than those chosen by any other method.

METEOROLOGY IN MAURITIUS

Results of Meteorological Observations taken in 1872 *at Mauritius; Monthly Notices of the Meteorological Society of Mauritius*, 1873; pp. 23 to 53.

THE work of meteorological observation and discussion at this important station continues, as shown by these papers, to be prosecuted under Mr. Meldrum's direction with marked energy and success. The observations at the observatory, which are made five times daily, embrace atmospheric pressure, temperature, humidity, cloud, rainfall, wind, thunder, lightning, and meteors, of which the "Results" present us with a full and carefully prepared summary. We observe with much satisfaction that a barograph is in operation at this important observatory, and very earnestly hope that future annual publications will give meteorologists what is greatly desiderated, viz., the data for the determination of the hourly barometric fluctuations of that region. It is stated that the monthly means of the dry and wet bulb thermometers have been derived from the observations at 6 and 9½ A.M. and 3½ and 9½ P.M.; but those of the barometer from the observations at 9½ A.M., 3½ P.M., and 9½ P.M. The formula employed in each case should in future be explicitly stated. We infer from an examination of the table that the barometric means are derived from the formula $\frac{9\frac{1}{2} + 2 \times 3\frac{1}{2} + 9\frac{1}{2}}{4}$; but as regards the thermometers, we have no means of knowing how the observations at the four hours were combined in deducing the mean temperature, since the means of temperature at these hours are not printed. Considering the hours at which the observations are made, the best formula for the mean temperature would be $\frac{9\frac{1}{2} + 3\frac{1}{2} + 9\frac{1}{2} + \text{min.}}{4}$. But the most satisfactory course would be to give the averages at the observed hours, leaving it to each to deduce from these the approximate mean temperatures. In all published annual results the simple averages of actual observations ought to be given, and these should in no case be made to give way to averages hypothetically deduced.

The rainfall has long occupied the attention of the Mauritius meteorologists, and a table is given showing the results of the rainfall at thirty-five stations. The annual amounts vary greatly, from an annual average of 33 in. at Gros Cailloux to 146 in. at Cluny. The important bearing of the rainfall on the products and health of the island has been ably pointed out by Mr. Meldrum. It is much to be desired that this very energetic society should establish stations at suitable points over the island, at which observations of pressure, temperature, wind, &c., would be made. The position of the island, its peculiar physical configuration, and variety of vegetable covering, afford remarkable facilities for the investigation of not a few meteorological problems, such as the influence of forests on climate, and the daily march and phases of the pressure, temperature, and humidity of the air as influenced by height, exposure, and the character of the vegetation in the immediate neighbourhood of the instrument.

The paper drawn up by Mr. Meldrum for the Vienna Meteorological Congress regarding the practicability and utility of storm warnings is of considerable value, the subject having long received full and able investigation at Mr. Meldrum's hands, and the correctness of his deductions been abundantly tested by the success attending the warnings issued by him. The chief, and indeed only difficulty, in the way of the complete success of the system of warnings at Mauritius is the uncertainty as to when and where an advancing cyclone may recurve.

But the most valuable article in these papers is the one by Mr. Meldrum "On a rainfall periodicity corresponding with the sunspot periodicity." The article is a fine instance of a broad and comprehensive discussion of the question dealt with through its details, and of an extreme caution in constant exercise in drawing the conclusions. The result arrived at is this:—Whether we take the annual rainfall over the largest possible portion of the globe for short periods, or over a smaller portion for a longer period, we arrive at the same result, viz., an increase of rain at or near the epochs of maximum sun-spot area, and a decrease of rain at or near the epochs of minimum sun-spot area. The exceptions are few and trifling, being only such as might be expected in this as in other questions of physical research, and they all gradually and inevitably disappear from the results as the inquiry is made to cover more extended portions of the earth's surface and a longer interval of time.

Much interest attaches to the prosecution of the inquiry regarding the relations of solar and atmospheric changes into other branches of meteorology, such as the pressure, temperature, humidity, electricity, and motions of the air. Does the temperature fluctuate with the sun-spot period? and if so, is the increase and decrease uniform and simultaneous over the globe, or do the warm and cold periods differ widely in different regions? How is the distribution of atmospheric pressure affected? Are the inequalities intensified or reduced, or does the difference find expression chiefly in a greater or less disturbance of the atmosphere, resulting in an increase or decrease of the daily fluctuation as measured by the observed differences in the readings made, say at 9 A.M. from day to day? In the further development of "the meteorology of the future," these are some of the more important questions that will be first inquired into.

OUR BOOK SHELF

A Manual of Metallurgy. By W. H. Greenwood, F.C.S., Associate of the Royal School of Mines. (London and Glasgow: W. Collins, Sons, and Co., 1874.)

THE author states that the work is "primarily designed" for the use of students preparing for the advanced stage of the examinations of the Science and Art Department. This, the first volume, contains 250 pages, of which 150 are devoted to iron and steel. And it may be observed that as there is an excellent treatise on the Metallurgy of Iron, by Bauermann, in Weale's Series, this part is less needed by students than the second, in which the metallurgy of copper, lead, zinc, silver, gold, mercury, nickel, cobalt and aluminium, will be described.

Mr. Greenwood has availed himself of his notes of Dr. Percy's lectures at the Royal School of Mines, and has spared no pains in gathering materials for the work from original memoirs, as well as from the few well-known French and German metallurgical works. The chapters on fuel and fire-clays are necessarily brief; but those relating to iron are satisfactory. The author has described the recent improvements made with a view to supersede manual labour in puddling—such as the rotative furnaces of Siemens and Danks. Siemens' process for the production of wrought iron direct from the ore is also given, and the excellent researches of Bell, Snelus, and Dr. W. M. Watts are duly noticed. In the rest of the book, the metallurgy of tin, antimony, arsenic, bismuth, and platinum are somewhat briefly treated. The various processes are illustrated by fifty-nine well-chosen engravings.

The book contains some curious verbal errors; but, viewed as a whole, we have no hesitation in saying that the work is good, and may be recommended to the class of readers for whom it is intended.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Fossils in Trap

THE occurrence of fossils in the volcanic rocks of our Scottish carboniferous series is by no means uncommon. A conspicuous example was described by me in the "Transactions of the Geological Society of Glasgow," vol. ii. p. 97.

The plant remains thence derived were afterwards figured and described by Mr. Binnie of Manchester, and Mr. Carruthers of the British Museum, and in the latter institution are deposited large polished slabs of entire trees, together with specimens of the enclosing rock.

At a later period a tooth of *Ctenodus cristatus* was also discovered in the same beds. The analysis of the rock was made by the late Mr. John Wallace Young, and given by him in the *Chemical News*, vol. xiii. p. 73.

The rock enclosing these remains is so heavy and compact, so completely devoid of any signs of stratification when fractured, that all previous investigators, from Prof. Buckland in 1819, down to Dr. Bryce in 1865, dismissed it with a conclusive click of the hammer as simply *trap rock* not likely to contain fossils.

The condition in which the fossils are found may be described in the precise words of your Nova Scotia correspondent (NATURE, vol. x. p. 398), as "*indissolubly united with trap;*" nevertheless, there is every probability that originally the enveloping matrix must have reached the fossils in the shape of volcanic ash, or, more likely still, in the shape of a thick fluid sediment enveloping the trunks of the trees as they stood erect, with their broken branches, leaves, and fruit scattered around them. We have numerous instances of ash-beds overlying limestone beds containing corals, and I suspect Mr. Honeyman's "*trap rock in a fluid state*" would resolve itself into a rock of the nature above indicated; at all events, it would be very interesting to geologists on this side to receive specimens for closer examination. With regard to the possibility of fossils being enclosed and preserved in fluid lava, I may mention that when at Catania in 1867, I was informed by Prof. Sylvestri that oak trees on Mount Etna when overtaken by lava streams are not actually annihilated, but the lava forms a sort of hollow cylinder around the trees, in which they are carbonised, and the silex contained in the wood collects in a fused mass at the bottom of the trunk. Such fused masses I met with at the foot of some of the stems of trees excavated by me at Arran, and numerous pebbles, evidently derived from the same source, are to be picked up on the shore between the Fallen Rocks and the Scriden at the north end of Arran.

E. A. WUNSCH

Loch Ranza, Arran, Sept. 19

Chrysomela Banksii

IN answer to Mr. Moggridge (NATURE, vol. x. p. 355), his conjecture as to *Chrysomela Banksii* is correct; though whether the fluid it emits is irritating or not I cannot say. It is a habit possessed by the allied genera Linæ and Timarchæ.

Camberwell Road, Sept. 16

H. POWER

Meteor

THE following is an account of a brilliant meteor which appeared at 8 53 P.M. on Wednesday, Sept. 16:—

Size: about four times that of Jupiter.

Colour: blue, with a red tail.

Brightness: throwing a shadow deeper than that of a full moon.

Angular measurement of tail: from 12° to 15°.

Duration: about 15″.

Direction of course: N.W.

Zenith distance of point of disappearance: 75°.

The brilliancy of the tail threw a red light on the surrounding landscape.

G. H. HOPKINS

Bisterne Close, Burley, Hants, Sept. 16

THE INTERNATIONAL CONGRESS OF ORIENTALISTS

THE second meeting of students of Oriental Literature and Science has been brought to a successful termination under the presidency of Dr. Samuel Birch, Keeper of the Oriental Antiquities in the British Museum. On Monday, the 14th inst., the Congress was opened at the Royal Institution, 21, Albemarle Street, when the president delivered a brilliant and highly interesting address upon the scope and value of these annual meetings.

"Our century," said Dr. Birch, "has seen a striking revival of Orientalism, and the discoveries in Mesopotamia, Egypt, India, and Persia have brought again into light, ancient and almost forgotten monarchies, religions, and tongues, as they existed 4,000 years ago. Modern travellers have left no accessible monument uncopied, and immense material is now at the student's disposal—for the first time, a contemporary history of recorded events in these old times. In Egypt only the other day, M. Mariette discovered fresh inscriptions at Karnak recording the conquest of Thothmes III. These enabled him, in a paper just read before the French Academy of Inscriptions, to propose important reforms in our Egyptian geography. Mr. George Smith's excavations at Kouyunjik have brought to light new Assyrian texts; whilst in India, General Cunningham's labours promise very important results. Every facility should be given for excavations in the East, especially for such as follow up the hints afforded by monumental information. Two monumental discoveries made in recent times are of supreme importance, namely the Canopus triglyph tablet and a bilingual inscription of Dali, 'Idalium,' in Cyprus. The Canopus stele has proved beyond a doubt, if doubt still lingered in dark corners, the truth of the decipherment of the hieroglyphs, whilst the Dali text has led to the recovery of the old Cyprian language, which turns out to be of Greek form. The Mesopotamian and Egyptian monumental discoveries make us acquainted with old submerged empires, and the Moabite stone is the most ancient document of alphabetic writing."

On Tuesday the second day's work commenced with the president's reception in the Egyptian and Oriental Department of the British Museum. The meeting of the Semitic Section, under the presidency of Sir Henry Rawlinson, took place in the theatre of the Royal Institution, where the learned Assyriologist delivered his opening address, in which he spoke on the great importance of the Semitic group of languages.

On the conclusion of this address Prof. Jules Oppert, in a lengthy speech delivered in French, brought before the meeting the result of his labours upon the second of the three inscriptions of King Darius at Behistun.

On Wednesday, after an entertainment by the Right Hon. Sir Bartle Frere, and a reception at Kew Gardens by Dr. Hooker, in his capacity as President of the Royal Society, the Turanian Section opened its session at King's College, under the presidency of Sir Walter Elliot. After his address a very *interesting* paper was read "On the Study of Turanian Languages," by Prof. Hunfalvy, of Hungary. In this paper the Professor showed by numerous facts adduced from Hungarian, Wogul Ostiak, and Finnish, that the established notion of Turanianism seems not to be well founded, and that by the accepted maxims it leads the student into many errors. The author endeavoured to show, consequently, that the same method of studying, which has created the Aryan and Semitic linguistic science, must also be applied to the Turanian languages, and that before such a perfect scientific method is reached, every comparative study of them must be unavailing.

Perhaps the most interesting paper was entitled "The State of the Chinese Language at the time of the invention of Writing," by Rev. J. Edkins, in which the author treated of the state of opinion as to the time of the invention of Chinese writing, the changes in the language during the last 1,200 years, and from the time of Confucius till A.D. 600; and laid down the theory that the Chinese characters are an index to the sound of the words at the time of the invention, and that from them may be learned the phonetic changes that have since taken place; they are also an index to the nature and extent of the vocabulary then in use, and a measure of the civilisation that had then been attained.

On Tuesday, the 17th, the Aryan Section sat at the Royal Institution under the presidency of Prof. Müller, whose address was listened to with absorbing interest; we have only space for a few extracts.

What is the real use of an International Congress of Orientalists? asked the president. During the last hundred, and still more during the last fifty years, Oriental studies have contributed more than any other branch of scientific research to change, to purify, to clear, to intensify the intellectual atmosphere of Europe, and to widen our horizon in all that pertained to the science of man, in history, philology, theology, and philosophy. The East, formerly a land of dreams, of fables and fairies, has become a land of unmistakeable reality; the curtain between the West and the East has been lifted, and their old forgotten home stands before them again in bright colours and definite outline. Before all, a study of the East has taught the same lesson which the northern nations once learnt in Rome and Athens, that there are other worlds beside our own, that there are other religions, other mythologies, other laws, and that the history of philosophy from Thales to Schlegel is not the whole history of human thought. In all these subjects the East had supplied parallels, and all that was implied in parallels, viz., the possibility of comparing, measuring, and understanding. The comparative spirit was the truly scientific spirit of the age, nay, of all ages. An empirical acquaintance with single facts did not constitute knowledge in the true sense of the word. He advocated the founding of chairs in our Universities for the languages and antiquities of various extinct and existing peoples, and spoke of the great service which properly educated missionaries might render as pioneers of scientific research. What I should like to see is this, he said: I should like to see ten or twenty of our non-resident fellowships, which at present are doing more harm than good, assigned to missionary work, to be given to young men who have taken their degree, and who, whether laymen or clergymen, are willing to work as assistant missionaries on distant stations; with the distinct understanding that they should devote some of their time to scientific work, whether the study of languages, or flowers, or stars, and that they should send home every year some account of their labours. These men would be like scientific consuls, to whom students at home might apply for information and help. Thirdly, Prof. Muller continued, I think that Oriental studies have a claim on the colonies and the colonial governments. The English colonies are scattered all over the globe, and many of them in localities where an immense deal of useful scientific work might be done, and would be done with the slightest encouragement from the local authorities, and something like a systematic supervision on the part of the Colonial Office at home. Now, we should bear in mind that at the present moment some of the tribes living in or near the English colonies in Australia, Polynesia, Africa, and America, are actually dying out, their languages are disappearing, their customs, traditions, and religions will soon be completely swept away. To the student of language the dialect of a savage tribe is as valuable as Sanskrit or Hebrew, nay, for the solution of certain problems, more so; every one of these languages is the growth of thousands and thousands of years, the workmanship of millions and millions of human beings. If they were now preserved they might hereafter fill the most critical gaps in the history of the human race. And this is not all. The study of savage tribes has assumed a new interest of late, when the question of the exact relation of man to the rest of the animal kingdom has again roused the passions, not only of scientific inquirers, but also of the public at large. Now, what is wanted for the solution of this question is more facts and fewer theories, and these facts can only be gained by a patient study of the lowest races of mankind.

At Dr. Birch's, who gave a reception in the afternoon at his official residence, an agreeable surprise awaited the guests. A secretary of legation had just arrived from the French Embassy, bearing an official and holograph letter to Dr. Birch from the Comte de Jarnac, and a handsome jewel-box, containing the rare and exceedingly honourable decoration of the Golden Palm Branches, or, to speak more correctly, the order of "Officier de l'Instruction Publique," a decoration only conferred upon persons of the highest scientific and literary merit, and confined to ten personages only.

The Hamitic Section assembled in the evening at the rooms of the Society of Biblical Architecture, Conduit Street. The most interesting paper was "On the Place of the Lake or Sea passed by the Israelites at the Exodus," by his Excellency Prof. Brugsch, in French. The author was listened to with rapt attention as he endeavoured to demonstrate that the Hebrews did not really cross the Red Sea, but between the Bitter Lakes lying to the north of the sea. This paper will be printed.

On Friday, the 18th, the Aryan and Archæological Sections met, and in each valuable papers were read.

In the afternoon of Saturday, the Ethnological Section, under the presidency of Prof. Owen, C.B., F.R.S., Superintendent of the Natural History Collections in the British Museum, met at the rooms of the Royal Asiatic Society, where a very large attendance was gathered to hear the interesting addresses of the distinguished president.

In illustration of contributions to the physical elements of ethnology, Prof. Owen referred to the five quarto volumes of photographic illustrations, with descriptions of the various castes, outcasts, traders and artisans, soldiers, outlaws, and primitive hill tribes of Hindostan, issued by the India Office, under the editorial care of Sir John William Kaye and Dr. Forbes Watson. To Dr. Mouatt, when in the Indian service, Prof. Owen had first been indebted for the materials of a report on the natives of the Andaman Islands, published by the British Association in 1861. The language of that dwarf Nigrito race had been well studied by Mr. Homfray, and additional information had been recorded by other scientific Indian officers, as by Surgeon Francis Day and the lamented P. Stoliczka. In a brief summary of present knowledge of the Nigrito and Papuan tribes the president laid stress upon the geological and collateral evidences of their origin on land tracts related in time to recent geological changes, to a period vastly remote in relation to historical time. Their interest to the ethnologist was the retention by certain, now insulated, groups of Nigritos, of an early—he would not say primitive—condition of humanity, like those of some pre-historic races in Europe. The shell-mounds of the Andaman Islands, *e.g.*, were compared with the "kitchen-middens," on North European shores. The Nigritos of the Andamans, like those of New Guinea, waged an unmitigated, uncompromising hostility, by force and fraud, against invaders. Such disposition was comparable to that which the brute species in their wild state bear to man. These Nigritos seem to realise instinctively their fate through contact with a higher race. Since the establishment of a penal settlement in the smaller of the Andaman Islands, kindly disposed ladies have taken in hand Mincopie girls; some swam back to the larger islands, others, retained and taught to the age of puberty, were returned to their tribe. They forthwith resumed its condition and cast off their garments. The men girt the abdomen, against pangs of hunger, with a flexible tendril; but in other respects these dwarf Nigritos exhibit quite a prelapsarian, or quadrumanous, unconsciousness of nakedness. After touching upon previous hypotheses that had been broached of the origin of Hill-men, Mincopies, and Papuans, the president summarised the observations on which he founded a recommendation to ethnologists to pause before concluding that the present disposition of land and sea was necessarily associated with the origin of such low forms of humanity, and to admit the possibility, if not probability, of its contemporaneity with the latest geological changes on the earth's surface. Prof. Owen then passed to the consideration of the origin, antiquity, and race-characters of the first scientifically known civilised people. This part of the discourse was illustrated by a diagram of the dynasties and reigns of Egyptian kings, and enlarged views from photographs of portrait-sculptures of individuals of the third and fourth dynasties, of a Hykshos Pharaoh of the sixteenth dynasty: of a monarch of the twentieth dynasty, belonging to the native race, after the expulsion of the "Shepherd Kings," and of Pharaohs of the Greek race, including one of Cleopatra, which, from the circumstances of its discovery, supported the belief of its being a true likeness of that queen. To ethnologists the greatest interest was attached to the evidences of the physiognomies of the race that founded the civilisation of ancient Egypt. They are supplied by statues of eminent individuals of well-to-do families, discovered in the temples connected with the tombs. Some are of wood, some of alabaster, some of granite; but the noblest of these is the statue of Chephren, the Phra, or Pharaoh of the fourth dynasty, who built the second of the great pyramids of Ghizeh. It was discovered by Mariette Bey in the temple contiguous to that mighty organised cairn or tomb. It is of life-size; the Pharaoh is seated on his throne, carved out of one block of the beautiful, intractable, and rare mineral called "diorite." Photographs of this statue were exhibited. The face, with features as refined and intellectual as those of a modern European, has a calm, dignified expression, free from the conventionality of the statues of later monarchs. The anatomy of the frame was as true as in works of art from the chisel of Michael Angelo. According to the "table" exhibited, this king lived B.C. 4200. The sculptor wrought thirty-seven centuries before Phidias. What was the period of incubation necessary to attain such perfection in both the creative and mechanical departments of the noblest of the arts? Prof. Owen then briefly discussed the evidence for this high antiquity. To the most philosophic and knowledge-loving of the kings of the Greek dynasty we owe the translation into Greek of the records written in the language, and entrusted to the care of the respective priesthoods of Egypt and of Judæa. Between these records there was great discrepancy. Egypt had risen from a long mythical period to become a state ruled by one mortal Phra, or king, at a period, according to Manetho, contemporaneous, according to Esdras, with the Creation! A later Pharaoh, Cheops, was, according to the Egyptian chronicle, building his pyramid at a time when, according to the Hebrew reckoning, the world was being submerged by the Flood. The attitude of the ethnologist, in the presence of the Manethonian and Septuagint documents, was plain; he has to put away any partiality towards one or other of the respective authors; any presumption of the superior claims of either to recognition; and to test them by facts open to discovery, and on which the truth-getting faculty can base scientific conclusions. This attitude in reference to the Hebrew record is taken by the "Palestine Exploration Fund." A like investigation of the remains of edifices, works of art, monumental records akin to the "Moabite Stone," geological and zoological phenomena, had been carried on in Egypt for a longer period and with richer results than elsewhere. Among the labourers in this monumental field the president more especially paid tribute to Lepsius and Mariette Bey. The testimonies bearing on Manetho's chronology were then briefly enumerated. From these the president inferred that if the Sebennyte priest had erred it was by omission rather than commission; and he expressed his conviction that the chronology set forth in the diagram best squared with the sum of scientific evidence on this important question. In the present palæontological evidence of the antiquity of the human race, 7,000 years seemed but a brief period to be allotted to the earliest civilised administratively-governed community; it seemed natural that such conditions should first have arisen in a land with such unique blessedness of soil and climate as Egypt; and with the high racial character of the people flourishing under its antediluvian Pharaohs. The question as to the origin of this race was then discussed; followed by remarks on the evidence of the periods required for the origin of the leading varieties of the human species. Some remarks on the evidences of the relative antiquity of Egyptian and Chaldæan civilisation followed; and the president concluded by appealing to his fellow Orientalists to cast aside prepossessions as to time, place, affinity, race, for which there may not be any groundwork of rightly observed well-determined data, and to bring to bear on the dark vistas of the past the pure, dry light of science.

Dr. Forbes Watson, M.A., read a most important scientific paper "On the establishment, in connection with the India Museum and Library, of an Indian Institute for Lecture, Inquiry, and Teaching, and on its Influence on the Promotion of Oriental Studies in England, on the Progress of Higher Education among the Natives of India, and on the Training of Candidates for the Civil Service of India."

The India Museum and Library, Dr. Watson said, would afford a most suitable nucleus for the organisation of a centre for Indian research and information. Such a purpose would be best effected by establishing in connection with the museum and library an institute for lecture, inquiry, and teaching on all Indian subjects. Such an institute would prove highly advantageous from every point of view. The chief object of all scientific institutions is the promotion of research and the dissemination of information—the increase of knowledge, and the increase in the number of people possessed of it. In either direction these institutions would prove more effective if combined than if separate. It is clear that the public usefulness of the museum and library would be extended by the lectures and teaching of the institute; and that the action of the institute on the other hand would be supplemented by its connection with the museum and library.

The following is the plan of arrangement for an Indian Museum which would divide the whole of its contents into a series of groups and sub-groups affording a connected view of the country and its people. This plan takes account of the library as well; in fact, with regard to some of the divisions, reference must be made to the library for a large portion of the materials, and with regard to others for the whole of them.

A. THE COUNTRY AND ITS RESOURCES.

1. *Physical Geography.*
   - *a.* Boundaries and Administrative divisions.
   - *b.* Orography.
   - *c.* Hydrography.
   - *d.* Meteorology.

2. *Natural History.*
   - *a.* Geology and Mineralogy.
   - *b.* Soil.
   - *c.* Flora.
   - *d.* Fauna.

3. *Agriculture, Manufactures, and Commerce.*
   - *a.* Raw produce, mining agriculture, forestry, &c.
   - *b.* Trade and manufactures.
   - *c.* Tools, machinery, processes.
   - *d.* Locomotion by land and water.
   - *e.* Harbours, lighthouses, docks, warehouses, fairs and markets, telegraph and postal communications.
   - *f.* Currency, banks, &c.
   - *g.* Coins, weights, and measures.

B. THE PEOPLE AND THEIR MORAL AND MATERIAL CONDITION.

4. *Ethnography.*
   - *a.* Races.
   - *b.* Castes and religious sects.
   - *c.* Population and vital statistics.

5. *History and Administration*
   - *a.* Philology.
   - *b.* Archæology.
   - *c.* Mythology.
   - *d.* Historical Geography.
   - *e.* Political and Administrative History.
   - *f.* Legislation.
   - *g.* Current Administration.

6. *Domestic and Social Economy.*
   - *a.* Food and cooking.
   - *b.* Houses and buildings.
   - *c.* Clothing and personal decoration.
   - *d.* Manners and customs.
   - *e.* Health and sanitation.
   - *f.* Education.
   - *g.* Religion.
   - *h.* Fine and decorative art.
   - *i.* Science and literature.

Several other papers were taken as read, and the session of the Congress ended with the choice of St. Petersburg for the meeting of the Congress of 1875. In the evening the Lord Mayor entertained the members at a magnificent banquet at the Mansion House.

COMMON WILD FLOWERS CONSIDERED IN RELATION TO INSECTS *

II.

THE Common Heaths (*Erica tetralix* and *E. cinerea*) offer us another very ingenious arrangement. In *E. tetralix* (the Cross-leaved Heath), for instance, the flower is in the form of a bell (Fig. 15), which hangs with its mouth downwards, and is almost closed by the pistil (*st*), which represents the clapper. The stamens are eight in number, and each terminates in two cells, which diverge slightly, and have at their lower end an oval opening. But though this opening is at the lower end of the anther cells the pollen cannot fall out, because each cell, just where the opening is situated, touches the next anther cell, and the series of anthers thus form a circle surrounding the pistil and not far from the centre of the bell. Each anther cell also sends out a long process, which thus forms a series of spokes, standing out from the circle of anthers. Under these circumstances, a bee endeavouring to suck the honey from the nectary cannot fail firstly to bring its head in contact with the viscid stigma, and thus to deposit upon it any pollen derived from a previous visit; and secondly, in thrusting its proboscis up the bell, it inevitably comes in contact with one of the anther processes, which acts like a lever and dislocates the whole chain of anther cells when a shower of pollen falls from the open anther cells on to the head of the bee. †

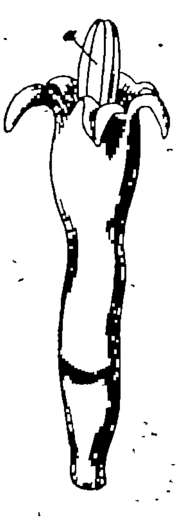


FIG. 15.

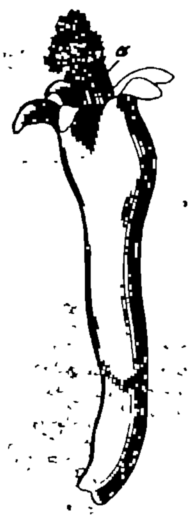


FIG. 16.

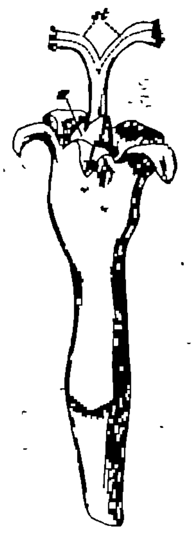


FIG. 17.

In the allied genus Vaccinium there is a similar arrangement, but the anther cells are closed, not by touching one another, but by resting against the style, so that the style itself closes the openings until the anthers are distributed by the proboscis of the bee. *V. uliginosum* is much larger than *V. myrtillus*, and consequently more conspicuous; *V. myrtillus*, on the other hand, has the compensating advantage of being richer in honey.

The genus Arbutus also is said to agree in essentials with Vaccinium.

In many cases the effect of the colouring and scent is greatly enhanced by the association of several flowers on one branch or raceme, as, for instance, in the Wild Hyacinth, the Lilac, and other familiar instances. In the great family of Umbelliferæ this arrangement is still further taken advantage of, as in the common Wild Chervil (*Chærophyllum sylvestre*).

In this group the honey is not, as in the flowers just described, situated at the bottom of a tube, but lies exposed, and is therefore accessible to a great variety of small insects. The union of the florets into a head is, moreover, not only of advantage in rendering them more conspicuous, but also effects a considerable saving of time, as it enables the insects to visit a given number of insects more rapidly, and consequently renders their fertilisation more certain than if they had stood singly.

The self-fertilisation which, in small flowers such as these, would otherwise naturally occur, is provided against by the fact that the flowers are generally proterandrous, that is to say, the stamens ripen before the pistil, and the latter is not mature until the former have shed their pollen. In some cases, as, for instance, in Myrrhis, the flowers of one head are all firstly in the male condition, and subsequently in that with mature stigmas, none of them arriving at the second stage until they have all passed through the first.

In *Chærophyllum* the petals are not symmetrical, the outer ones being considerably larger than the others, and in many umbellifers the florets themselves on the outer edge of the bunch or umbel are considerably larger than the inner ones.

This distinction is carried still further in the Compositæ, where

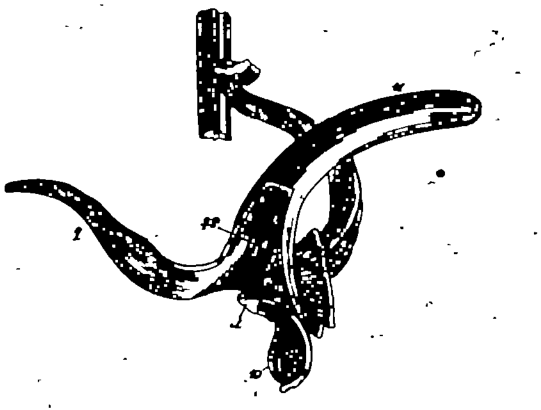


FIG. 18.

also the florets are so closely packed together that the whole umbel is commonly, though of course incorrectly, spoken of as a flower.

For instance, the heads of the common Daisy, as I need hardly mention, are not strictly speaking flowers, but bunches of flowers closely packed together on a common base or receptacle. The advantages of this arrangement are:—

1. That the flowers become much more conspicuous than would be the case if they were arranged singly.
2. That the facility with which the honey is obtained renders them more attractive to insects.
3. That the visits of the insects are more likely to be effectual,

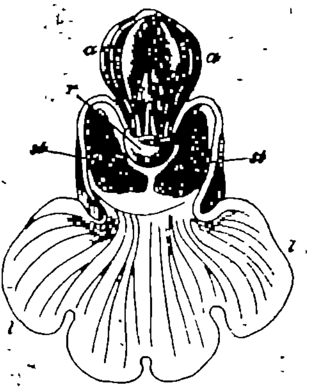


FIG. 19.

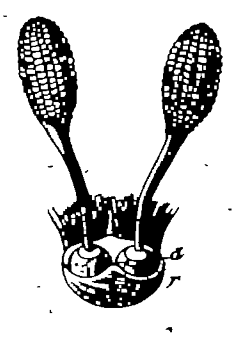


FIG. 20.

since the chances are that an insect which once alights, touches several, if not many, florets.

No wonder, therefore, that the Compositæ are the most extensive family among flowering plants, are represented in every quarter of the globe and in every description of station,* and contain nearly ten thousand species.

If we take, for example, the common Feverfew, or large white Daisy (*Chrysanthemum parthenium*), which has been well described by Dr. Ogle,† the flower-heads consist of an outer row of female florets, in which the tubular corolla terminates on the outer side in a white leaf or ray, which doubtless is useful in making the flower conspicuous. The inner florets are also tubular, but are small, yellow, and without rays. Each of these florets is furnished with stamens as well as a pistil. The stamens are united on their inner sides so as to form a closed tube, within which the pistil lies. They ripen before the pistil, and dehisce on their inner sides, so that the pollen is discharged into the upper end of the tube above the head of the pistil. When the flower opens the pollen is already ripe, and fills the upper part of the stamen tube. A floret in this condition is represented in Fig. 15. The pistil, however, also continues to elongate, and at length pushes the pollen against the upper end of the tube, which gives way, and thus the pollen is forced out of the tube, as shown in Fig. 16. The pistil itself terminates in two branches, which at first are pressed closely to one another, and each of which terminates in a brush of hairs (Fig. 17). As the style elongates this brush of hairs sweeps the pollen cleanly out of the tube, and it is then removed by insects. When the pistil has attained its full length two branches open and curve downwards so as to expose the stigmatic surfaces (Fig. 17, *st*) which had previously been pressed closely to one another, and thus protected from the action of the pollen. From this arrangement it is obvious that any insect alighting on the flower-head of the Chrysanthemum would dust its under-side with the pollen of the younger flowers, which then could not fail to be brought into contact with the stigmatic surfaces of the older ones. As the expansion of the flowers begins at the outside and thence extends to the centre, it is plain that the pollen of any given floret cannot be used to fertilise one situated on its inner side. Consequently, if the outer row of florets produced pollen, it would, in the great majority of cases, be wasted. I have, however, already mentioned that these florets do not produce pollen, while the saving thus effected enables them to produce a larger corolla. It is also interesting to observe that in these outer flowers the branches of the pistil do not possess the terminal brush of hairs which, in the absence of pollen, would be useless.

---

* Continued from p. 406.

† *Popular Science Review*, April 1870.

* Bentham, "Handbook of the British Flora," vol. i. p. 408; Jour. Linn. Soc. 1873, p. 335.

† *Popular Science Review*, April 1870.

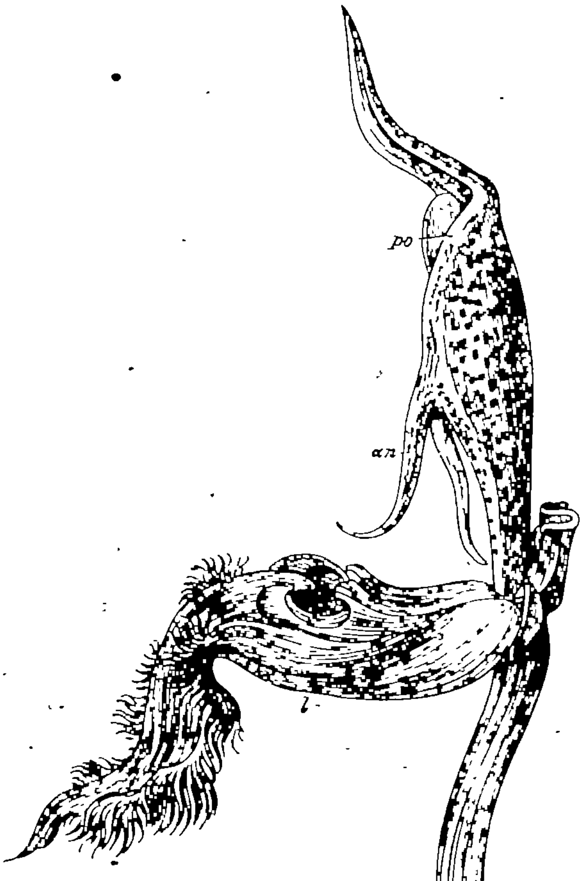


Fig. 21.

In other Compositæ, as in the Marigold, while the ray flowers produce no pollen, the disc flowers develop stigmas only. In this case, as in the Feverfew, the pistil of the ray flowers does not require or possess the terminal brushes of hairs, as there is no pollen to be swept out. The central flowers, on the other hand, though they develope no stigmas, require a pistil in order to force the pollen out of the anther tube. Hence the pistil is present as usual, but the head is simple and not bifid. This complete alteration of the function of the pistil is extremely curious

Perhaps no group of flowers offers more remarkable adaptations than the orchids, which have been so admirably described by Mr. Darwin.* As an illustration of our English species, I shall take the common early purple orchis (*Orchis mascula*), as being one of the commonest, if not the commonest, species; and a fair example of some of the remainder, which however differs in many interesting and important points.

Fig. 18 represents the side view of a flower, from which all the petals and sepals have been removed, except the labellum (*l*), half of which has been cut away, as well as the upper portion of the near side of the nectary (*n*). The pollen forms two masses (Fig. 19, *a a*), each attached to a tapering stalk, which gives the whole an elongated pear-like form, and is attached to a round sticky disk (*d*), which lies loosely in a cap-shaped envelope or rostellum (*r*). This envelope is at first continuous, but the slightest touch causes it to rupture transversely, and thus to expose the two viscid balls (Fig. 20, *d*). Now suppose an insect visiting this flower; it alights on the labellum, and pushing its proboscis down the nectary to the honey, it can hardly fail to bring the base of the proboscis into contact with the two viscid discs, which at once adhere to it, so that when the insect draws back its proboscis, it carries away the two pollen masses. It is easy to imitate this with a piece of grass, and to carry away on it the two pollen masses and their stalks. If, however, the pollinium retained this erect position when the insect came to the next flower, it would simply be pushed into or against its old position Instead however of remaining upright, the pollinia, by the contraction of the minute disc of membrane to which they are attached, gradually turn downwards and forwards, and thus when the insect sucks the next flower, the thick end of the club exactly strikes the stigmatic surface (*st*). The pollinium or pollen mass consists of packets of pollen grains, fastened together by elastic threads. The stigma, however, is so viscid, that it pulls off some of these packets, and ruptures the threads, without removing the whole pollinium; so that one pollinium can fertilise several flowers.

I cannot resist mentioning the case of Catasetum, one of the Vandeæ, which, as Mr. Darwin says, "are the most remarkable of all orchids." In Catasetum (Fig. 21) the pollinia and the stigmatic surfaces are in different flowers, hence it is certain that the former must be carried to the latter by the agency of insects. The pollinia, moreover, are furnished with a viscid disc, as in orchis, but from the large size of the flower, and the position of the honey, the insect has no inducement to approach, and in fact does not touch, the viscid disc. The flower, however, is endowed with a peculiar sensitiveness, and actually throws the pollinium at the insect. Mr. Darwin has been so good as to irritate one of these flowers in my presence: the pollinium was thrown nearly 3 ft., when it struck and adhered to the pane of a window. This irritability, however, is confined to certain parts of the flower of *Catasetum saccatum*, which is also shown in section in Fig. 22. In this figure it will be seen that the pollinium (*d p*) is curved, and in a state of considerable tension, but retained in that position by a delicate membrane. Now, insects alight as usual on the labellum of the flower (*l*), and it will be seen that in front of it are two long processes, or antennæ (*an*). In some species of Catasetum both these antennæ are highly irritable; in the present species the right-hand one is apparently functionless; but the moment the insect touches the left-hand one, the excitement is conveyed along it, the membrane retaining the pollinium is ruptured, and the latter is immediately jerked out of the flower by its own elasticity, with considerable force, with the viscid disc foremost, and in such a direction as to come in contact with the head of the insect which had touched the antenna.

I will only mention one other tropical flower, the very curious *Marcgravia nepenthoides*, described by Mr. Belt in his interesting work, "The Naturalist in Nicaragua." The flowers are disposed in a circle, and beneath them are suspended some pitcher-like vessels, which secrete a sweetish liquid, and thus attract numerous insects. These again bring birds, which can hardly fail to brush against the flowers, and thus convey the pollen from one to the other.

---

* Fertilisation of Orchids.

In the flowers hitherto described, while the several species offer the most diverse arrangements, we have met with no differences within the limits of the same species, excepting those dependent upon sex. I must now call attention to some cases in which the same species possesses flowers of two or more kinds, which sometimes, as in the Violet, are adapted to different conditions; but more frequently are so constituted as to ensure cross-fertilisation.

In some of the violets (*V. odorata*, *canina*, &c.), besides the blue flowers with which we are all so familiar, but which produce very little seed, there are other autumnal flowers, almost without petals and stamens, and which indeed have none of the appearance of true flowers, but in which the seeds are produced. As these curious flowers, however, have no relation to our present subject, I shall not now dwell on them.

I pass on to the genus Primula, which offers a most interesting case of dimorphism. The Cowslip and Primrose resemble one another in many respects, though the honey they secrete must be very different, for while the Cowslip is habitually visited during the day by humble bees, this is not the case with the Primrose, which, in Mr. Darwin's opinion, is fertilised almost exclusively by moths. (Jour. Linn. Soc., vol. x. p. 438.) This, however, is a digression.

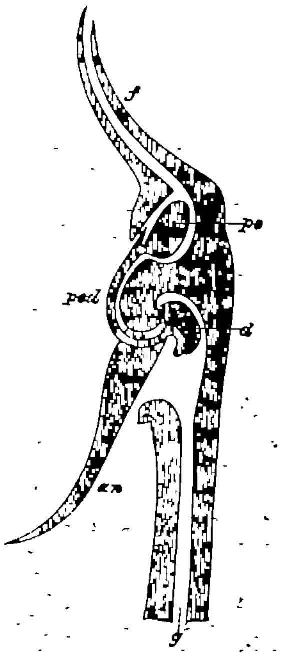


FIG. 22.

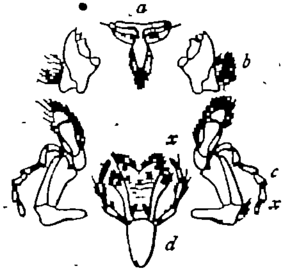


FIG. 23.

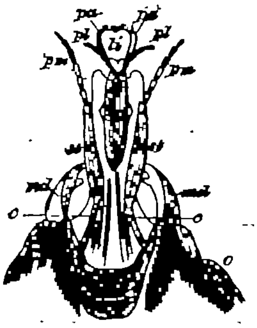


FIG. 24.

Corresponding differences occur in the Polyanthus and Auricula, and had long been known to gardeners, and even to school children (by whom the two kinds of flowers are known as "pin-eyed" and "thumb-eyed"), but it was reserved for the genius and perseverance of Mr. Darwin, to explain * the significance of this curious phenomenon, and the important part it plays in the economy of the flower. Now that Mr. Darwin has pointed this out it is sufficiently obvious: an insect thrusting its proboscis down a primrose of the long-styled form would dust its proboscis apart, which, when it visited a short-styled flower would come just opposite the head of the pistil, and could not fail to deposit some of the pollen on the stigma. Conversely an insect visiting a short-styled plant would dust its proboscis at a part further from the tip, and which, when it subsequently visited a long-styled flower, would again come just opposite to the head of the pistil. Hence we see that by this beautiful arrangement insects will carry the pollen of the long-styled form to the short-styled, and *vice versâ*.

There are other points in which the two forms differ from one another: for instance, the stigma of the long-styled form is globular and rough, while that of the short-styled is smoother, and somewhat depressed. The pollen of the two forms is also dissimilar, that of the long-styled being considerably smaller than the other, 7-7000ths of an inch in diameter against $\frac{10\text{–}11}{7000}$ or nearly in the proportion of three to two; a difference the importance of which is obvious, for each has to give rise to a tube which penetrates the whole length of the style, from the stigma to the base of the flower, and the tube in the long-styled form must therefore be nearly twice as long as in the other. Mr. Darwin has shown that much more seed is set if pollen from the one form is placed on the pistil of the other, than if the flower is fertilised by pollen of the same form, even if taken from a different plant. Nay, what is most remarkable, such unions in Primula are more sterile than crosses between distinct, though nearly allied species of plants, have in some cases been found to be.

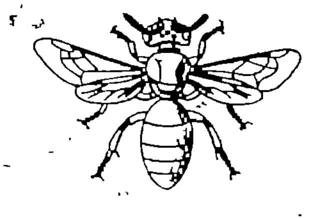


FIG. 25.

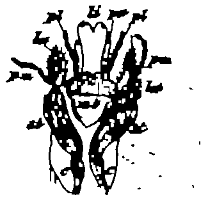


FIG. 26.

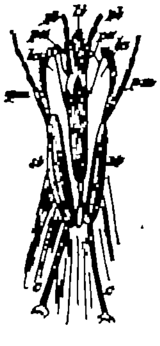


FIG. 27.

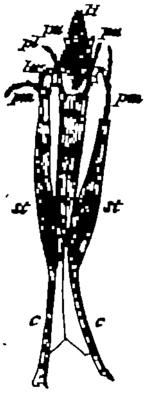


FIG. 28.

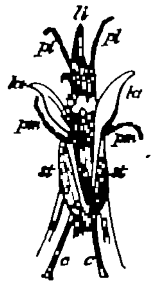


FIG. 29.

The majority of species of the genus Primula appear to be dimorphic, but not all.*

Mr. Darwin has pointed out † that several species of Linum are dimorphic in the same manner as the Cowslip and Primrose. *Lythrum salicaria*, however, ‡ is even more remarkable, since as was remarked by Vaucher, but first explained by Mr. Darwin, it presents us with three distinct forms (each contain-

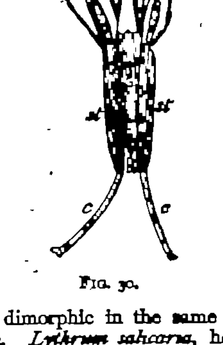


FIG. 30.

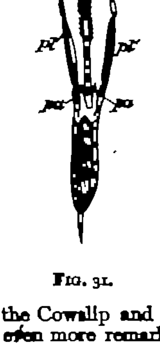


FIG. 31.

---

* *Linnean Journal*, 1862, p. 77.

* Scott, Proc. Linn. Soc., vol. viii., 1864, p. 80.
† Journ. Linn. Soc., 1863, p. 69.
‡ Linn. Journ. 1864, p. 169.

ing a pistil and two groups of stamens), which he calls, from the relative lengths of their pistils, the long-styled, mid-styled, and short-styled. In this species, also, it is remarkable that the seeds of the three forms differ from one another, 100 of the long-styled seeds being equal to 121 mid-styled or 142 short-styled. The pollen grains also not only differ in size (the long stamens having the largest-sized pollen grains, the middle-sized stamens middle-sized pollen grains, and the short stamens small pollen grains), but also in colour, being green in the longer stamens, and yellow in the shorter ones; while the filaments are pink in the long stamens, uncoloured in the shorter ones. Mr. Darwin has also proved by experiment that this species does not set its seeds, if the visits of insects ares prevented; in a state of nature, however, the plant is much frequented by bees, humble-bees, and flies, which always alight on the upper side of the flowers in the stamens and pistil.

He has also shown that in this species, as in Primula, perfect fertility can only be obtained by fertilising each form with pollen from stamens of corresponding length. This case is indeed most complex, as the pollen of each set of stamens, when applied to the same stigma, acts most differently, and it would appear that the greater the inequality in length between the pistil and stamens, the greater the sterility.

The genus Lythrum is also remarkable for the great differences existing between different species. *L. graefferi*, like *L. salicaria*, is trimorphic; while *L. thymifolia* is dimorphic; and *L. hyssopifolia* is homomorphic.

Let us consider the manner in which the bees are adapted to the flowers. Although we may in one respect say that the general organisation of the insect is modified with reference to these relations, still, as Muller, from whom the following facts are mainly taken, has well shown, the parts which have been the most profoundly modified are the mouth and the legs. If we are asked why we assume that in this case the mouth-parts and legs have been modified, the answer is that they depart greatly from the type found in allied insects, and that between this type and these modified examples various gradations are to be found.

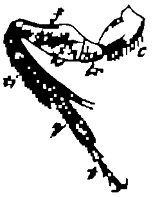


FIG. 32.

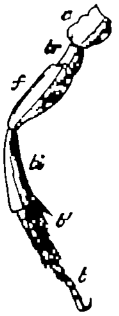


FIG. 33.

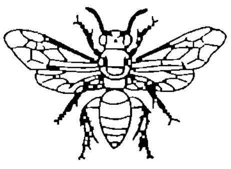


FIG. 34.

The mouth of an insect, say of a wasp (Fig. 23), is composed of (1) an upper lip, *a*, (2) an underlip, *d*, (3) a pair of anterior jaws or mandibles, *b*, and (4) a pair of posterior jaws or maxillæ, *c*. These two pairs of jaws work laterally, that is to say, from side to side, and not as in man and other mammalia, from above to below. The lower lip and maxillæ are each provided with a pair of feelers or palpi (*c* and *d*, *x*). The above figures represent the mouth-parts of a wasp, in which, as is very usually the case, the mandibles are hard and horny, while the maxillæ are more delicate and membranous. In the different groups of insects these organs present, however, almost infinite variations.

Fig. 24 represents the mouth-parts of a bee, Prosopis (Fig. 25). The bees belonging to this genus construct their cells in sand, or in dry bramble sticks, lining them with a transparent mucus, which they smooth down with their trowel-like lower lip and which hardens into a thin membrane. That the mouth of Prosopis probably represents the condition of that of the ancestors of the hive-bees before their mouthparts underwent special modifications, may be inferred from the fact that the same type occurs in other allied groups, as is shown in Fig. 26, which represents the mouth of a wasp (Polistes), also seen from below.

We may therefore consider that Prosopis shows us special adaptation for the acquirement of honey, and in fact though the bees belonging to this genus feed their young on honey and pollen, they can only get the former from those flowers in which it is on the surface. In Andrena (Fig. 27), Halictus (Fig. 28), Panurgus (Fig. 29), Halictoides (Fig. 30), and Chelostoma (Fig. 31), we see various stages in the elongation of the lower lip until at length it reaches the remarkable and extreme form which it now presents in the hive- and humble-bees, and which enable them to extract the honey from most of our wild flowers, though no bees have the proboscis so much elongated as is the case with some butterflies and moths; perhaps as Hermann Muller has suggested, because the necessity of using their mouths for certain domestic purposes has limited its specialisation in this particular direction.

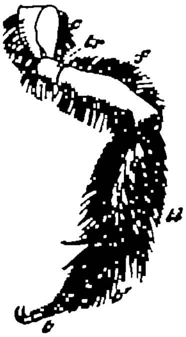


FIG. 35.

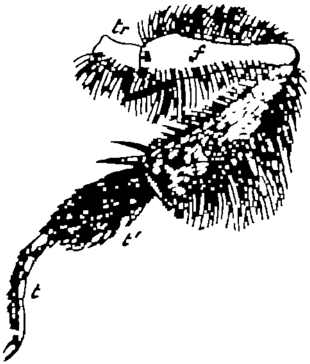


FIG. 36.

There are several flowers which are inaccessible to hive-bees, and to *Bombus terrestris*, which has a shorter proboscis than some of the other species belonging to that genus. Hermann Muller mentions, for instance, that he has often seen *Bombus terrestris* endeavouring, in vain, to suck the flowers of the Oxlip (*Primula elatior*). Having satisfied themselves that they were unable to do so, but not till then, they proceeded to cut a hole in the base of the tube, and thus arrived at the honey. This seems to show, he observes, that they act upon the results of experience, and not by what is called mere instinct. Indeed any one who has watched bees in greenhouses will see that they are neither confined by original instinct to special flowers, nor do they visit all flowers indifferently. Muller mentions several cases in which he has seen honeyless flowers visited by insects; *Genista tinctoria*, for instance, is frequently visited by insects in search of honey although it does not contain any.

Certain insects, on the other hand, confine themselves to particular flowers. Thus, according to H. Muller,

Andrena florea	visits	exclusively	*Bryonia dioica*,
Halictoides	,,	,,	species of *Campanula*,
Andrena hattorfiana	,,	,,	*Scabiosa arvensis*,
Cilissa melanura	,,	,,	*Lythrum salicaria*,
Macropis labiata	,,	,,	*Lysimachia vulgaris*,
Osmia adunca	,,	,,	*Echium*.

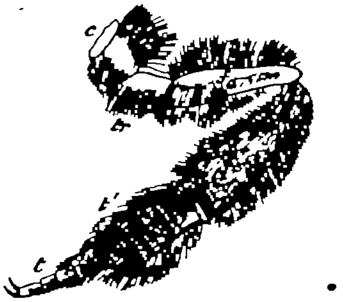


FIG. 37.

It would also appear that individual bees differ somewhat in their mode of treating flowers. Some humble bees suck the honey of the French Bean and the Scarlet Runner in the legitimate manner, while others cut a hole in the tube and thus reach it surreptitiously; and Dr. Ogle has observed that when he followed any particular bee she always proceeded in the same manner; some always entering by the mouth, others always cutting a hole. He particularly mentions that this was the case with bees of one and the same species, and infers, therefore, that they differ from one another in their degrees of intelligence; and his observations, though of course not conclusive, are interesting and suggestive.

If again we examine the hind legs of bees, we shall find similar gradations. In Prosopis (Fig. 32) they do not differ materially from those of genera which supply their young with animal food. Portions of the leg, indeed, bear stiff hairs, the original use of which probably was to clean this burrowing insect from particles of sand and earth, but which in Prosopis assist also in the collection of pollen.

Fig. 33 represents the hind leg of Sphecodes (Fig. 34), a genus in which the tongue resembles in form that of Halictus. Here we see the hairs decidedly more developed, a modification which has advanced still further in Halictus (Fig. 35), in which we see that the development of the hairs is most marked on those segments of the hind legs which are most conveniently situated for the collection and transport of pollen.

In Panurgus the same change is still more marked, and the pollen-bearing apparatus is confined to the tibia and first segment of the tarsus, a differentiation which is even more apparent in Anthophora. In these bees the pollen is simply entangled in the hairs of the leg as in a brush, but there are other genera, as for instance the humble bees and the hive bee, which moisten the pollen with honey, and thus form it into a sticky mass, which is much more easy to carry, and is borne, not round the leg, but on one side of it. In the humble bee (Bombus, Fig. 36), for instance, the honey is borne on the outer side of the hinder tibiæ, which are flattened, smoothed, and bordered by a row of stiff curved hairs, which thus constitute it a sort of little basket. Lastly, in the hive bee (Fig. 37), the adaptation is still more complete, the hairs on the first tarsal segment are no longer scattered, but are arranged in regular rows; and the tibial spurs inherited by Bombus from far-distant ancestors have entirely disappeared.

In some bees the pollen is collected on the body, and here also we find a remarkable gradation from Prosopis, which has only minute and simple hairs, like a wasp; through Sphecodes, a Nomada, in which the longer hairs are still few, and generally simple, though some few are feathered; to Andrena and Halictus, where the hairs are much more developed; a change which is more marked in Sarapoda, Colletes, and Megachile; still more so in Osmia and Anthophora; until we come to the humble bees, in which the whole body is covered with long feathered hairs.

Although flowers present us with all these beautiful and complex contrivances, whereby the transfer of pollen from flower to flower is provided for and waste is prevented, yet they are imperfect, or at least not yet perfect, in their adaptations. Many small insects obtain access to flowers and rob them of their contents. *Malva rotundifolia* can be, and often is, sucked by bees from the outside, in which case the flower derives no advantage from the visit of the insect. In *Medicago sativa*, also, insects can suck the honey without effecting fertilisation, and the same flower continues to secrete honey after fertilisation has taken place, and when apparently it can no longer be of any use. Fritz Müller has observed that, though *Posoqueria fragrans* is exclusively fertilised by night-flying insects, many of the flowers open in the day, and consequently remain sterile.

It is of course possible that these cases may be explained away; nevertheless, as both insects and flowers are continually altering in their structure and in their geographical distribution, we should necessarily expect to find such instances. Animals and plants constantly tend to adapt themselves to their conditions, just as water tends to find its own level.

I have been good-humouredly accused of attacking the little busy bee, because I have attempted to show that it does not possess all the high qualities which have been popularly and poetically ascribed to it. But if scientific observations do not altogether support this intellectual eminence, which has been ascribed to bees, they have made known to us in the economy of the hive many curious peculiarities which no poet had ever dreamt of, and have shown that bees and other insects have an importance as regards flowers which had been previously unsuspected. To them we owe the beauties of our gardens, the sweetness of our fields. To them flowers are indebted for their scent and colour, nay, their very existence in its present form. Not only have the brilliant colours, the sweet scent, and the honey of flowers been gradually developed by the unconscious selection of insects, but the very arrangement of the colours; the circular bands and radiating lines, the form, size, and position of the petals, the arrangement of the stamens and pistil, are all arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which renders these visits necessary.

Thus, then, I have attempted to point out some of the relations which exist between insects and our common wild flowers; the whole subject is one, however, which will repay most careful attention, for, as Muller has truly said, there is no single species the whole history of which is yet by any means thoroughly known to us, and while, with reference to the regions of thought brought before us by the president on Wednesday evening, few can hope themselves to assist in the progress of truth, the case is very different with reference to my subject of this evening, in which every one of us by care and perseverance may fairly hope to add something to the sum of human knowledge.

NOTES

We hear that it is most probable that Dr. T. Lauder Brunton, F.R.S., whose investigations in the science of therapeutics have made him so well known to physiologists and pathologists generally, will undertake the editorship of the *Practitioner*, rendered vacant by the death of Dr. Anstie.

The forty-seventh congress of German naturalists and physicists opened at Breslau on Sept. 18. The proceedings were opened by the eminent chemist, Prof. Loewig, who expressed his satisfaction at seeing so many foreigners, whose presence in that assembly, he added, was a living testimony to the truth that science was of no country. Capt. von Dechen read a paper upon the present state and the future prospects of geology. After him, Prof. Virchow, of Berlin, spoke upon miracles regarded from the scientific standpoint. The several sections were then constituted, and the members of the congress afterwards adjourned to a banquet. In the evening an open-air entertainment was given by the city, and a telegraphic greeting was sent to the Emperor.

The fortieth congress of the French Institute of the Provinces, *Les Mondes* informs us, opened at Rodez on Monday last, under the presidency of M. de Toulouse-Lautrec, and will last ten days. There are five sections, in which questions are discussed connected with the mathematical, physical, and natural sciences, agriculture, industry and commerce, anthropology and the medical sciences, history and archæology, philosophy, literature, the fine arts, and social economy. This is certainly comprehensive enough.

The last expedition for observing the transit of Venus is now on the point of leaving England for Egypt. It has developed into one of considerably greater magnitude than was at first intended. The Government expedition organised by Sir George Airy, instead of being located at Alexandria, will have its headquarters at Cairo, the longitude of which city is to be found by exchange of telegraph signals with Greenwich, for which purpose a branch station will be established for a time at Alexandria. For the actual observation of the transit, Cairo, Thebes, and Suez are selected, the longitude of the last two being obtained by exchanging telegraph signals with Cairo. The photographic branch of the enterprise will probably be at Thebes. Private expeditions have been organised, all of them in concert with the English Government one. The whole may be enumerated as follows:—English Government Expedition.—Chief captain, C. Orde Browne; photographic branch, Capt. Abney; astronomers, Mr. S. Hunter and Mr. Newton. Prof. Dollen, the Russian astronomer, and Col. Campbell have organised private expeditions to Thebes. Dr. Anvers proposes to be either at Cairo or Thebes, and Admiral Ommanney may also join the English party as an associate astronomer. The whole of the telescopes and huts from Greenwich are now on board the Peninsular and Oriental vessel *Hindostan*, which is to leave Southampton on the 1st proximo.

MR. LOUIS SEEBOHM, one of the chief photographers who embarked on the *Swatara* in June last as a member of the American Transit of Venus expedition, died at Bahia on July 22. He had been extremely ill during the voyage, and was ordered home by the medical officer of the vessel, but died of fever before he could be removed.

THE October number of Petermann's *Mittheilungen* will contain a valuable paper by Prof. H. Fritz on the geographical extension of the Aurora Borealis; the accompanying map, which contains the magnetic meridians, shows by a system of curves the places on the earth's surface from which the light is seen with equal frequency. Also a fine map of Haiti on the scale of $\frac{1}{1000000}$, with accompanying description; and the continuation of Dr. Nachtigal's contribution on the tributaries of the kingdom of Baghirmi, in which he gives some account of the fauna and flora of the region and of the manners, customs, and condition of the people. There is also a paper translated from the Russian of L. Kostenko, giving a personal account of the country between Khiva and Fort Kasala on the Sir-Daria.

A MOVEMENT is on foot among the students of the University of St. Andrews with the object of electing Mr. Darwin to the Rectorial chair in the room of Lord Neaves, who retires in November. On the last occasion a large number of the students were favourable to the election of a scientific man in the person of Prof. Huxley, and as he lost his election by only three votes, the Darwinians are encouraged to prosecute the candidature of their nominee. The election will take place on the fourth Thursday of November.

THE *Daily News* of Saturday last has a letter, dated Kandavan, Aug. 8, from its correspondent with the *Challenger*, giving an account of a short cruise from Wellington, New Zealand, which was left on July 6, to the Fiji Islands. The trawling and dredging was very successful, and many zoological and botanical specimens have been obtained. Among the treasures obtained by the trawl was a live nautilus, the only one caught alive since the ship left England. The *Challenger* was to proceed to the New Hebrides and Torres Straits, where it was expected to arrive about the beginning of this month.

M. CORENWINDER has contributed to a recent meeting of the Société des Sciences of Lille an exhaustive series of observations on the processes of respiration and nutrition in plants. He supports M. Claude Bernard's view, that the process ordinarily known as the respiration of plants—the decomposition of the carbonic acid of the atmosphere—is really a process of digestion, and that simultaneously with this, plants carry on, by day as well as by night, a true process of respiration, similar in all respects to that performed by animals, consisting in an oxidation of the carbonaceous matters of their tissues. By a very careful series of analyses, performed mainly on the lilac and maple, M. Corenwinder determined that the proportion of nitrogenous matter in the leaves gradually and progressively diminishes from the time that they emerge from the bud till their fall; the proportion of carbonaceous matter increases very rapidly during April and May, and then remains nearly stationary till October; while that of incombustible substance increases during the whole period of vegetation. He distinguishes, therefore, two periods in the vegetative season of the plant—the first period, when nitrogenous constituents predominate, is that during which respiration is the most active; the second, when the proportion of carbonaceous substance is relatively larger, is the period when respiration is comparatively feeble, the carbonic acid evolved being again almost entirely taken up by the chlorophyll, decomposed, and the carbon fixed in the true process of digestion.

PROF. H. HOFFMANN of Giessen has made some interesting experiments on the permanence of varietal and specific characters in the case of the French Bean and Scarlet Runner (*Phaseolus vulgaris* and *multiflorus*). A very large number of attempts to fix special varieties which were casually produced invariably failed, the tendency towards reversion to the ancestral form being apparently irresistible. On the other hand, no one of the characters which are ordinarily relied on to distinguish the two species from one another is constant, but is liable, under certain circumstances, to disappear. Dr. Hoffmann has also made a similar series of experiments on the Common Red Poppy (*Papaver Rhœas*). Constant cultivation for six years produced no perceptible variation; but in the seventh year several varieties in the colour, and in the next year in the form of the petals, made their appearance, tending towards an assimilation to *P. dubium*.

THE *Gardener's Chronicle* announces a new material for paper in a well-known American grass, *Zizania aquatica*. It is stated that the Zizania yields fully as much of the raw material as esparto, and has the great and peculiar merit of being comparatively free from silicates. Paper made from it is quite as strong and quite as flexible as that made from rags; it is easily bleached, economical in respect of chemicals, pure in colour, and remarkably free from specks and blemishes. It is especially recommended for the manufacture of printing paper. The grass grows in enormous quantities in our Canadian Dominion, on the shores of Lakes Erie, St. Clair, Ontario, &c., and it is affirmed that a supply of 100,000 tons annually may be looked on as certain. Its habitat is swamps, ponds, and shallow streams, where it grows to a height of from 7 to 8, or even to 12 and 14 ft. The structure is similar to that of rice, except that the flowers are unisexual. The grains are largely used as an article of food by the native Indians, some tribes depending on them to a large extent for their subsistence. The flavour is said to be superior to that of most other cereals, and it has long been known from these properties as "Canada Rice."

THE will of the late Girolamo Ponti, of Milan, which has just been published in the *London Gazette* by order of Lord Derby, is likely to give rise to some trouble before it can be carried into effect. The testator has bequeathed a considerable portion of his property to the "Academies of Science of London, Paris, and Vienna," to be divided among them in equal proportions, for the purpose in each case of founding, with the proceeds resulting from investment, two competitions yearly on the subjects of Mechanics, Agriculture, Physics and Chemistry, Travels by Sea and Land, and Literature. The committees to be appointed by the societies are instructed to give preference to those competitors who will have advanced any of the subjects mentioned by original discovery. The relatives of Signor Ponti are to dispute the will, and those London societies that think they have claims upon the legacy are urged to bring them forward at once. There can be no doubt which societies are meant in the case of Paris and Vienna; and at first sight there appears to be little doubt as to what body the title of "Academy of Science of London" would most appropriately apply.

AT the meeting of the Paris Academy of Sciences held Sept. 14, Dr. A. W. Hofmann announced that his two students, MM. Tiemann and Haarmann, who had obtained vanilline (the aromatic principle of the vanilla bean) from pine sap, propose to manufacture this substance on a large scale. The sap of a tree of medium height gives vanilline to the value of 100 fr., and the wood is not injured by the extraction of the sap. This will be the second vegetable product manufactured by purely chemical methods.

THE first fungus exhibition held in Scotland was opened in Aberdeen on Friday. The idea of the exhibition was first suggested by the Rev. Mr. Ferguson, of New Pitsligo, in the *Scottish Naturalist* for April. The suggestion was readily taken up by fungologists and men of science, and the result was an exhibition which those entitled to speak with authority say was never equalled in this country. The specimens numbered about 7,000. Almost every county in Scotland made large contributions, while England and Wales sent a number of exhibits. In fact, almost every fungologist in Britain contributed specimens.

IN an address on Education at Rochdale on Saturday, Mr. Jacob Bright urged the claims of Owens College, Manchester, to assistance from the national exchequer, and hinted that a time was approaching when the enormous revenues of Oxford and Cambridge would be made more productive to the country.

THE members of the *Tegetthoff* Austrian Polar Expedition have arrived at Hamburg. They everywhere in Norway met with a very cordial welcome. The new country, as far as explored, comprises five islands, and contains hares and foxes. When rescued, the members of the expedition were in rags, and for a fortnight had been short of provisions and of firing. They were compelled to shoot all the sledge dogs, as the animals showed signs of madness. The members of the expedition will, it is expected, reach Vienna to-morrow.

A NOTICE has been issued from the Science and Art Department that the Classes in Chemistry (Prof. Frankland), Biology (Prof. Huxley), Physics (Prof. F. Guthrie), and Applied Mechanics (Prof. Goodeve), have been tranferred to the new buildings, South Kensington, where they will open in the beginning of October.

MR. ANDREW MURRAY writes to the *Gardener's Chronicle* that he has, within the last few weeks, made some observations at the Ochil Hills, Kinross-shire, on *Pinguicula* and *Drosera*, with reference to the fly-digesting powers they are asserted to possess. He states that he found the leaves of *Pinguicula* close, quite independently of the fact of a fly being in them or not. "The leaves are found with their margins in all stages of curling over, some with no insect on them much more curled over than others with several." The secretion which Dr. Hooker states kills a captured insect he finds is glutinous, and he believes it does not fall on to the insect, but that death results from the secretion adhering to and closing up the spiracles by which the insect breathes. With regard to Dionæa, he suggests that it should be carefully noted (1) whether the secretion is never present until after an insect has been captured; (2) whether it is always present after one has.

AMONG the recent additions to the Manchester Aquarium is fine specimen of the Monk or Angel Fish, between five or six feet in length, and weighing at least one hundred pounds. With the exception of an example of very similar dimensions brought to the Brighton tanks about a year ago, but since dead, it is one of the largest yet recorded as taken on the British coasts. This specimen was captured at Colwyn Bay, near Conway, and is still in the most healthy and perfect condition. A number of young herring, of which fish the Manchester Aquarium now possesses many hundreds, were consigned last week by the curator, Mr. W. Saville-Kent, to the aquarium at the Crystal Palace; most of these arrived in safety, and are of especial interest as being the first of the species successfully introduced at that institution.

THE additions to the Zoological Society's Gardens during the past week include a Chimpanzee (*Troglodytes niger*); a Bay Antelope (*Cephalophus dorsalis*), and three Royal Pythons (*Python regius*), from West Africa, presented by Mr. C. B. Mosse; a King Vulture (*Gyparchus papa*) from South America, presented by Mr. G. L. Brumschweiler; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Capt. Hallett; two Little Bitterns (*Ardetta minuta*), European, presented by Mr. A. A. van Bemmelen; an Alligator (*Alligator mississippiensis*) from Demerara, presented by Capt. Turner; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, deposited.

MARITIME CONFERENCE

THE conclusions come to by the recent Conference on Maritime Meteorology have been forwarded to us with the following letter:—

"Sir,—I have the honour to inform you that the Permanent Committee of the International Meteorological Congress at Vienna (1873), at whose suggestion the recent Conference for Maritime Meteorology was held in London, has resolved to forward the Resolutions adopted at that Conference for publication at once, thus anticipating the publication of the full Official Report of the Conference. The Permanent Committee will feel deeply obliged if you can find space for them.

"ROBERT H. SCOTT,
"Secretary to the Permanent Committee."

Resolved—"That there should be but one form of Meteorological Register for the Navies and Merchant Services, and that those who cannot fill the log should keep part of it."

Questions.	*Resolutions.*
I.—OBSERVATIONS—	
Columns 1 to 6.*—*Date and Position of the Observations.*	
Is it your opinion that a fresh column should be added headed "Course and distance by the log in every watch of four hours?"	That an additional column should be given in the log for "Course and distance." That the course should be expressed in degrees, and not in points. That the question of hours, 4-hourly periods, as proposed by Captain Toynbee, should be adopted.
Columns 7 and 8.—*Currents.*	
	That observations on the "direction and rate" of currents be transferred to the column for Remarks.
Column 9.—*Magnetic Variation.*	
Is it desirable to give an additional column for the "Direction of ship's head"?	That an additional column be given in the log for the direction of the ship's head, and the amount of heel to port or starboard. That the total compass-error and not variation only be given. That the Conference expresses its opinion that the lettering on the English compass should be adopted by all nations for meteorological purposes.
Columns 10 and 11.—*Wind Direction and Force.*	
Is it possible to employ an anemometer at sea, so as to give trustworthy results?	That a decided answer to this question cannot at present be given, but it is desirable that various anemometers should be tested by special ships, and that a special form of four extra columns should be prepared for the purpose of recording such observations.
Can the use of the Beaufort scale be made universal?	That the use of the Beaufort scale should be continued, with the addition of the amount of sail which Beaufort's ship would have carried had she been rigged with double topsails. Also that the direction and force of the wind should be recorded at the *time* of observation, and not estimated for a certain number of previous hours. Also, that they should be recorded every two hours.
Columns 12 and 13.—*Barometer.*	
To what degree of minuteness is it necessary to observe this instrument?	To one-hundredth of an inch at sea, or its equivalent in the metric scale.

---

* The numbers of the columns refer to the Brussels Abstract log.

Columns 14 and 15.—*Thermometers, Dry Bulb and Wet Bulb.*

Should these observations be required from all ships?	That wet and dry bulb observations are desirable, and should be obtained whenever possible.

Column 16.—*Forms and Direction of Clouds.*

Is this column sufficient, or should any notice be taken of more than one stratum of clouds?	That the upper and lower clouds should be recorded in separate columns, and that the direction from which *upper* clouds come should be recorded when possible.

Column 17.—*Proportion of Sky Clear.*

Is it not advisable to substitute for this heading "Proportion of sky clouded"?	That it is preferable to give the proportion of sky clouded instead of the entry "proportion of sky clear," as recommended by the Brussels Conference.

Column 18.—*Hours of Rain, Fog, Snow, &c.*

Is it desirable to retain this heading, or to substitute for it and No. 23, a column headed "Weather by Beaufort Notation"?	That it is desirable to retain this heading, but that the use of Beaufort's Notation may be continued by those accustomed to it.

Column 19.—*State of the Sea.*

Should this be given according to a numerical scale?	That a numerical scale (0 – 9) be adopted, and that an extra column should be given to the observation. The direction of the sea swell, or the different swells, to be given in the original column.

Columns 20 to 22.—*Temperature of Sea Surface, Specific Gravity, Temperature at Depths.*

Is it desirable to retain these columns, or can the observations when taken be inserted in the column for "Remarks"?	That the first two columns should be retained. That sea temperatures at depths should not be required from all ships, and should be recorded in the "Remarks."

Column 23.—*Weather.*

Vide the resolution on Col. 18.

Column 24.—*Remarks.*

That the "Remarks" as asked for by the Brussels Conference should be adopted, with the exception of the observations of temperature with coloured bulbs at sea.

II.—INSTRUMENTS.

What patterns of instruments should be employed for any observations which may require them?	That the question of the precise pattern of instruments is not of very great importance, so long as they satisfy the tests applied at the several central Institutions and are compared with standard instruments; but it is recommended that they shall be of a pattern as easy as possible for reading.
Is there any reasonable possibility of introducing the metric and centigrade systems for general use at sea?	The recommendation respecting the use of the metric and centigrade systems as expressed at the Vienna Congress was approved, and it was recommended that a table of conversion should be entered in each log to enable Captains to compare barometers which have different scales.

III.—INSTRUCTIONS.

Is it possible to devise a general form of Instructions to ensure uniformity in regard of methods of observation and registration?	That the Instructions should be suited to the log now proposed by the Conference, but modified to meet the various requirements of different nations.

The Conference requested that Capt. Toynbee's proposed form of log should be lithographed and the English "Instructions" printed for circulation amongst its members.

IV.—OBSERVERS.

What control should be exercised over the Observers as to their instruments and registers?	That it is necessary that all instruments used should be compared with standard instruments, either at the central or the filial institutions (if such exist), before and after the voyage; and that the corrections and date, &c., of the comparison should be entered in the log.
Is it desirable that all instruments employed should be the property of the central establishment, and *lent* to the observers?	That it is desirable that the instruments should be the property of the central office. That it is necessary that a careful examination should be made into the quality of the observations recorded, and that the attention of the observers should be specially directed to any errors which may have been detected.

V.—CO-OPERATION OF THE ROYAL NAVY.

To what extent can ships of war assist in forwarding the ends of meteorological inquiry?	The Royal Navy can furnish more complete observations than are possible on board merchant ships, as, *e.g.*, Deep-sea soundings and temperatures. Observations in unfrequented parts of the sea. Special experiments. It is most desirable that the duty of observing should be intrusted to some responsible Officer. It is therefore resolved that the Authorities of the Navies shall be requested to continue to give such assistance to the prosecution of meteorological science as circumstances shall permit.

A Report was handed in which had been drawn up by a number of the members who were in the Naval Services of some of the countries represented, and it was decided that the following resolutions which it contained should be adopted in lieu of those given above:—

1. "It is very important that the organisation of meteorological inquiry as regards the Navies of all countries should be arranged in accordance with the principles and stipulations laid down by the Conference for Marine Meteorology generally; and it is further important that the results of all observations made on board ships of war in any country should be rendered accessible for discussion by the central station for maritime meteorology in that country without prejudice to any subsequent publication by the respective Naval Authorities."

2. "The Conference, while admitting that the introduction of measures calculated to improve the condition of meteorological inquiries in the Navy must be left to the Authorities of the respective Navies, is nevertheless of opinion that all care should be taken to secure uniformity as to mode of observation, and especially to provide for the comparison of all instruments used with the respective standard instruments of the Central Institutes."

3. "The Conference considers it to be its duty to request that those entrusted with the management of scientific affairs on board men of war will lend their strenuous support in securing from the Naval Authorities in each country such regulations as will place meteorological inquiry on board such ships in as favourable a position as may be deemed consistent with the execution of the ordinary duties of the Service, and will also induce the commanders to render to such inquiries all the assistance and furtherance in their power. The Conference, knowing that such regulations must be framed according to the requirements of each country, expresses, nevertheless, its opinion that, inasmuch as meteorological observations require considerable experience, they should be entrusted to experienced Officers on board suitable vessels."

4. "Although the Conference is of opinion that, as far as the general scope of meteorological inquiry goes, the same form of register should be supplied to merchant ships as to men of war, it declares it will be most desirable that, besides the regular observations, a more extended scale for scientific inquiry should be adopted on board ships of war, as in such cases there is a large number of suitable officers, as well as more means for carrying on the service. As examples of observations which are of importance for the development of Maritime Meteorology, over and above the regulations embodied in the scientific instructions given to Naval expeditions for the special purpose of the advancement of science, the following suggestions may be enumerated:—

(*a*) "Possibility of carrying out accurate observations on the velocity of the wind by anemometers at sea.

(*b*) "Possibility of employing rain-gauges satisfactorily at sea.

(*c*) "Observations with Regnault's and other hygrometers, and experiments on the best mode of observing wet and dry thermometers, and the best position to place them in on board ship.

(*d*) "Currents at the surface and at depths to be observed with great minuteness, with the special object of defining their limits.

(*e*) "The comparison of various instruments, among which are expressly mentioned that of aneroids with mercurial barometers. It is further deemed very desirable that frequent comparisons should be instituted between the instruments used at sea and meteorological stations on shore in various countries.

(*f*) "Deep-sea soundings and temperatures, with specimens of water.

(*g*) "The collecting of information on Ocean Meteorology at outlying stations.

(*h*) The furnishing of synchronous observations at 0h. 43m. G. M. T., in accordance with the suggestion and request of the United States Signal Office."

VI.—Discussion.

Can general suggestions be thrown out as to the most profitable mode of discussing the observations?	That it is desirable that every Institution should publish the observations and results in such a manner that every foreign institute can incorporate them with its own observations and results in the easiest way possible; that is, by preserving the number of observations, together with any means derived from them, for single square degrees. That it is further desirable that, whatever charts be published, the results for single square degrees should be published in a tabular form. That it seems desirable for the use of the sailor that each chart should have reference to only one element, or, at least, only to elements closely related to each other.

VII.—Subjects of Inquiry.

To what extent can a division of labour, as regards subjects of inquiry, be carried out in a spirit of fairness to the collecting and discussing establishments respectively?	That the division of labour, as regards investigations, can only be carried out by mutual agreement between the several institutions; and each institution should announce to other institutions what investigations it proposes to undertake. It is very desirable that such divisions of labour should be effected.

VIII.—Sailing Directions.

In how far are purely practical investigations, such as the preparation of sailing directions, admissible for a scientific institution?	That the sailor wants the result of experience alone, and he must receive assurance that his observations have been turned to use. When these results of experience have been given, the theorist may point out the reason why certain routes are the best.

It was resolved, that Capt. Toynbee's remarks on the programme should be printed in full, with extracts from the remarks of other gentlemen, should they contain important suggestions.

THE BRITISH ASSOCIATION

Reports

Report of the Committee on Luminous Meteors, by Mr. Glaisher.—The appearance of meteors noticed in published journals, and otherwise ascertained by the committee during the past year, include some striking examples of such remarkable exhibitions, discussed and investigated very ably by astronomers, as well as of others passing almost unobserved excepting by accidental gazers. A few such large meteors were doubly observed in England. Some have been visible in the day-time, while many other large and small fire-balls have been described to the committee, of which it is to be regretted that notices have hitherto only reached them from single observers. The months in which these phenomena have been most abundant were September, December, and January last, April, June, and, again quite recently, the last few days of July and beginning of August of this year. The report contains descriptions of the brightest of these meteors, and an account of Prof. Galle's calculations and inquiries regarding the real cause of two large meteors which passed over Austria on the 12th and 19th of June last, with the probable path that he assigned to them. If a mass of burning sulphur found on the ground immediately after the disappearance of the latter meteor is not considered presumably meteoric, no occurrence of a fall of aerolites, as far as the committee is aware, has taken place during the past year.

The annual star-showers have been watched for with the usual attention of observers in correspondence with the committee; and the results of their combined observations are described, with accounts of some other occasional star-showers, at some length in the descriptive part of the report. Although little important information was thus added this year to our present well-known star-showers of January, April, and October, and the cometary meteor-showers of November 14 and 27, connected with Tempel's and with Biela's comet, all of which, in spite of very favourable weather for their observations, were this year most remarkable by their non-appearance; yet the fluctuating intensities of these showers at their successive periodic dates are an important element to record; and in the case of the star-showers of August 10 and December 12 of the past year, the watch was at least attended with more positive success. Duplicate observations of meteors were obtained in them, and the general centre of divergence of each of these two meteor-currents was pretty exactly ascertained. Bright meteors were more frequent on each of these two nights than is at all usual in ordinary exhibitions of those showers. It will be found among these observations that the return of Biela's meteor-shower on the 27th of November last disappointed expectation, and the small extent and rapid departure of that meteor-cloud from the earth's neighbourhood is clearly shown by its visibility as a star-shower only for a single year.

The duplicate observations described in former reports have been reduced at the request of the committee by Mr. T. H. Waller, whose report of these calculations is added, and whose conclusions of their real heights and velocities are without doubt very accurate and complete.

The publication of Capt. Tupman's observations of shooting stars in the Mediterranean during the years 1869-71, with the list of radiant points obtained from them and shown on a pair of charts accompanying them by Capt. Tupman, is now brought to a close, and the catalogue and charts have been sent to astronomers and correspondents of the committee in England and abroad, and in America, and discussions of these in foreign scientific journals have appeared, showing the important light in which the appearance of this valuable new meteor catalogue has been regarded. Its principal part, the comparative catalogue of his meteor-showers with those of other observers, and the charts on which they are projected, are presented in this report, with Dr. Schmidt's similar catalogue (the remaining two principal meteor-shower lists, of which no account has yet appeared in these reports), thus placing before readers of recent volumes of these reports all the material contributions to this branch of meteoric astronomy that have yet been made.

They are summed up in a very concise catalogue at the end of this report by Mr. Greg, who has selected, to corroborate such observations already published in his former lists, the greater part of Dr. Schmidt's and Capt. Tupman's observations, and has included them with his own former collection, thus forming a very extended catalogue founded on all the similar work of his contemporaries and predecessors, and omitting but few genuine meteoric showers, chiefly in the southern hemisphere, which have only been observed by Dr. Neumayer in Australia.

Following the method of Dr. Weiss, viz. to calculate the radiant points of those comets of early and recent times whose orbits are believed to pass near the earth, a list of such comets for both the northern and southern hemispheres is annexed to Mr. Greg's catalogue, and the cases where they corroborate each other are pointed out. Many important and well-known comets are found to have meteor-showers as their present representatives, as would, perhaps, be still more apparent if more reliable orbits of comets could be used; but the coincidences are, however, numerous enough and sufficiently exact to render desirable the further cultivation of cometary astronomy by the help of star-shower observations.

Report on Isomeric Cresols, by Dr. Armstrong.—Little has been done by the committee during the past year. *Para* and *ortho* cresols have been obtained from ordinary cresylic acid, but it has not been with certainty determined whether the *meta* cresol is likewise present, or whether these are the sole constituents of this substance.

Report of the Committee for the Utilisation of Sewage, by Prof. Corfield.—The committee has been unable, from want of funds, to carry on the quantitative experiments as they would have wished. Of the total nitrogen supplied to the farms during the year March 25, 1873, to March 24, 1874, 37·7 per cent. was recovered in the crops, during the preceding year 41·7 per cent. was recovered, while during the first year of the experiments the nitrogen recovered amounted to 26 per cent. The committee will be enabled, through the liberality of a gentleman, to carry on their investigations during another year.

SECTIONAL PROCEEDINGS

SECTION A—Mathematics

On the Construction of a perfectly Achromatic Telescope, by Prof. G. G. Stokes.

At the meeting of the Association in Edinburgh, in 1871, it was stated that it was in contemplation actually to construct a telescope by means of discs of glass prepared by the late Mr. Vernon Harcourt, which should be achromatic as to secondary as well as to primary dispersion. This intention was subsequently carried out; and the telescope, which was constructed by Mr. Howard Grubb, was now exhibited to the Section. The original intention was to construct the objective of a phosphatic glass containing a suitable percentage of titanic acid, achromatised by a glass of terborate of lead. The percentage of titanic acid was so chosen that there should be no irrationality of dispersion between the titanic glass and the terborate. As the curvature of the convex lens would be rather severe if the whole convex power were thrown into a single lens, it was intended to use two lenses of this glass, one in front and one behind, with the concave terborate of lead placed between them. It was found that provided not more than about one-third of the convex power were thrown behind, the adjacent surfaces might be made to fit, consistently with the condition of destroying the spherical as well as the chromatic aberration. This would render it possible to cement the glasses, and thereby protect the terborate, which was rather liable to tarnish. At the time of Mr. Harcourt's death two discs of the titanic glass had been prepared, which it was hoped would be good enough for employment, as also two discs of terborate. These were placed in Mr. Grubb's hands. On polishing, one of the titanic discs was found to be too badly striated to be employed; the other was pretty fair. As it would have required a rather severe curvature of the first surface and an unusual convexity of the last to throw the whole convex power into the first lens, using a mere shell of crown glass behind to protect the terborate, Prof. Stokes thought it more prudent to throw about one-sixth of the whole convex power into the third or crown-glass lens, though at the sacrifice of an *absolute* destruction of secondary dispersion, which by this change from the original design might be expected to be just barely perceptible. Of the terborate discs, the least striated happened to be *slightly* muddy from some accident in the preparation; but as this signified less than the striæ, Mr. Grubb deemed it better to employ this disc. The telescope exhibited to the meeting was of about 2¼ in. aperture, and 28 in. focal length, and was provided with an objective of the ordinary kind, by which the other could be replaced, for contrasting the performance. When the telescope was turned on to a chimney seen against the sky and half the object-glass covered, in the case of the ordinary objective, vivid green and purple were seen about the two edges, whereas with the Harcourt objective there was barely any perceptible colour. It was not, of course, to be expected that the performance of the telescope should be good, on account of the difficulty of preparing glass free from striæ, but it proved to be quite sufficient to show the possibility of destroying the secondary colour, which was the object of the construction.

On Cyclone and Rainfall Periodicity in connection with the Sunspot Periodicity, by Charles Meldrum.

The catalogue of cyclones experienced in the Indian Ocean, from 1847 to 1873, submitted last year, indicated that during this period the number of cyclones in the space between the equator and 34° S. lat. and the meridians of 40° E. and 110° E. are much greater in the years of maximum than in the years of minimum sunspot frequency.

It will now, and in subsequent reports, be shown that not only the number of cyclones, but their duration, extent, and energy, were also much greater in the former than in the latter years, and that there is a strong probability that this cyclonic fluctuation has been coincident with a similar fluctuation of the rainfall over the globe generally.

The present communication is confined to the twelve years 1856–67, comprising a complete sunspot cycle.

With regard to the cyclones of the Indian Ocean, the investigation is based upon the extensive collection of observations made by the Meteorological Society of Mauritius on the assumption that the observations are so numerous that no cyclone of any considerable extent or violence can have escaped detection.

A chart has been prepared for noon on each day of the period during which a cyclone lasted. The chart shows the positions of the vessels, the directions and force of the wind, the state of the weather and sea, &c. In this way the position of the centre of the cyclone is ascertained for each day; then, by examining the several charts, the duration, extent, &c. of the cyclone are determined.

The number of cyclones thus examined for the twelve years is 113, and their tracks have been laid down on six charts.

The total cyclonic area in 1860 and 1861 was about twelve times greater than in 1856 and 1857, and nearly eight times greater than in 1867; in short, all the factors were greater in the years of maximum sunspot frequency. It is evident from the table that the cyclonic area increased rapidly from 1858 to 1860, and diminished slowly from 1861 to 1866. The registers for the years 1856, 1857, 1866, and 1867 have been examined with special care in order that nothing might be omitted; and, to give the utmost possible weight to those years, every instance of even an ordinary gale has been taken into account. In 1856 there was no great hurricane at all, and the same may be said of 1857, 1866, and 1867. From the chart for 1806 it will be seen that in April of that year there was a number of small cyclones. The south-east trade-winds and north-west monsoon were in collision for a considerable time, and several cyclonic eddies of short duration were formed.

If we could obtain good values of the mass of air in motion and the velocity of the wind, it would probably be found that the ratios of cyclonic energy were greater than those of cyclonic area, for in the maxima years the cyclones were much more violent than in the minima years. Assuming the mass to be nearly proportional to the area, and the velocity of the wind in a strong gale to be 55 miles, in a whole gale 70 miles, and in a hurricane 85 miles an hour, the amount of cyclonic energy in 1860 was about eighteen times greater than in 1856, the squares of the velocities being as three to five.

Although the results are necessarily rough approximations, yet the fact that the number and violence of the cyclones of years of maximum sunspot were far greater than in the years of minimum sunspot is beyond all doubt.

When a great hurricane takes place in the Indian Ocean, the disabled ships are obliged to put into the nearest port, and the newspapers in their shipping intelligence announce the arrival of the vessels, the dates and localities of the bad weather, and the amount of damage sustained. For upwards of twenty years the *Commercial Gazette* of Port Louis has published all arrivals of vessels and all maritime events which have been reported by them. Considering, then, the geographical position of Mauritius, a cyclone periodicity, if one exists, should be traceable in the shipping intelligence. Now, from Table II., which gives the published reports for 1856, 1860, and 1867, it will be seen that the number of storms and the damage sustained in 1856 and 1867 were insignificant compared with the long list of hurricanes and disasters in 1860.

Table III. gives as complete a list of hurricanes and storms experienced in Mauritius as I have hitherto been enabled to prepare. The list comprises only such storms as from the violence of the wind committed considerable damage.

Table IV., which contains a list of Bourbon (Réunion) hurricanes and gales from 1733 to 1754, shows also the number of hurricanes that occurred in the maximum and minimum sunspot years.

For the two islands the number of cyclones in the maxima years was thirty-six, and for the minima years nineteen. This result is favourable.

It would appear also from M. Poey's researches, and from investigations made at Mauritius in 1872, that the cyclones of the West Indies are upon the whole subject to the same periodicity. The rainfall for the twelve years under discussion is given in Tables V. to IX. It thence appears from the rainfall at sixty-seven stations that the maximum fall was in the years 1859 to 1862, and the minimum in the years 1857, 1858, and 1864. We thus find a certain degree of correspondence between the cyclone and rainfall fluctuations; and it is possible that if we had returns from America the correspondence would be much greater; for it would appear from researches by Mr. G. M. Dawson, that the level of the American great lakes was considerably less in 1867–68 than in 1859–61. (The year 1867 has been almost the only exception to the rule in Europe since the commencement of the century, and as most of the stations are in that part of the world the results for 1856 and 1857 are not so favourable as for previous cycles).

A large number of additional rainfall returns has been received from Europe and other parts of the world, and the results, which will be communicated in another report, afford fresh evidence of a rainfall periodicity.

(The paper was accompanied by several elaborate tables).

SECTION B—Chemical Science

On some Opium Derivatives, by Dr. C. R. A. Wright.—The action of free chlorine on codeine is to produce higher polymerides, especially tricodeine, from which again, by the action of hydrochloric acid, apocodeine is formed. This apocodeine may be looked on as three molecules of codeine *minus* six molecules of water. Narceine is feebly basic, but it has a strong attraction for hydrochloric acid, giving rise to the crystallisable hydrochloride $C_{23}H_{29}NO_9 + HCl$. If the salt is dissolved in boiling water, crystals are obtained containing six molecules of $C_{23}H_{29}NO_9$ plus one molecule of HCl. Basic chlorides, probably not definite compounds, have also been obtained. With excess of hydrochloric acid at 100° the elements of water are removed from narceine, and we get $C_{23}H_{27}NO_8$. The hydrochloride of this base is non-crystallisable. By the action of glacial acetic acid on codeine there is produced diacetyl codeine, $C_{36}H_{40}2(C_2H_3O)N_2O_6$. Acetic acid acts in a similar way on morphine, a considerable quantity of triacetyl morphine being also produced. Acetic anhydride gives rise to the formation of an isomeric diacetyl morphine. We have, therefore,—

α diacetyl morphine . . . . crystallisable
and β ,, ,, ... non-crystallisable.

Butyric and benzoic acids give analogous compounds; so also do acetic acid and strychnine. The following general formulæ for the morphine and codeine salts are given:—

$$M + nHX - nH_2O,$$
$$C + nHX - nH_2O,$$

when HX = a monobasic acid.

On a Phenomenon noticed on boring a Well, by Dr. Andrews.—The author described a remarkable jet of almost pure marsh-gas, obtained on boring a well near Belfast. The borings first descended through about 33 ft. of silt, and then reached a gravelly deposit 7 ft. in thickness, interspersed with organic *débris*. It was from this deposit that the marsh-gas was evolved.

Reaction of Hydrogen, Peroxide, &c., by Mr. Fairley.—The author believes that he has succeeded in preparing hypochlorous acid according to the equation $H_2O_2 + Cl_2 = 2HClO$. By the action of hydrogen peroxide on bleaching powder, and on other hypochlorites, oxygen is evolved; thus, with potassium hypochlorite, $KClO + H_2O_2 = KCl + H_2O + O_2$. Chloric acid has no action on hydrogen peroxide; neither has sulphuretted hydrogen in the absence of air. By the action of ozone on hypochlorous acid there seems to be produced perchloric acid.

On the General Equations of Chemical Decomposition, by Prof. Clifford, F.R.S.—This paper was also read before Section A. The author thinks that chemical equations may be brought under a general formula. Thus, $H_2 + Cl_2 = 2HCl$. If we assume that there is a structure common to the hydrogen and the chlorine atoms, also a structure confined to the hydrogen and likewise a structure confined to the chlorine atoms, we may represent this equation thus: $XYY + XZZ = 2XYZ$, when X represents the common structure and Y and Z the structures which are confined to hydrogen and chlorine respectively. So $2H_2 + O_2 = 2H_2O$ may be represented thus: $2XY + XXZZ = 2XXYZ$. These equations involve no hypotheses, because the fundamental facts of the molecular theory are now firmly established. Reasoning from these and similar equations, the author deduces the result that the ordinary equations of chemistry, such as those just stated, are expressive of facts, and that the hydrogen molecule really consists of two equal atoms.

On the presence of Cyanogen in Commercial Bromine, and a means of detecting it, by Dr. T. L. Phipson.—The author states that commercial bromine often contains cyanogen; by adding an equal weight of iron filings and four to five times its weight of water to the bromine, stirring, filtering, and allowing the filtrate to remain for twenty-four hours in a closed bottle, a precipitate of *Prussian blue* is thrown down if cyanogen is present.

On a Sesqui-sulphide of Iron, by Dr. Phipson.—The author describes a greenish black salt having the composition Fe_2S_3. This salt is produced by precipitating a ferric salt by means of ammonium sulphide in the presence of a free chlorite or hypochlorite. The salt is soluble in hot water, also in ammonia, giving an emerald green liquid.

On the Chlor-Bromides and Brom-Iodides of the Olefines, by Prof. Maxwell Simpson, F.R.S.—The author described various substances obtained by acting on ethylene, &c., with iodine chloride, with bromine chloride, with bromine iodide, &c. In the case of ethylene the substance C_2H_4BrI, C_2H_4ClI, and C_2H_4ClBr, were described. These bodies may also be obtained by agitating the chloride bromide or iodide of ethylene with a solution of iodine or bromine chloride: thus, $C_2H_4Br_2 + BrI = C_2H_4BrI + Br_2$. The reaction $C_2H_4Cy_2 + BrCy = C_2H_4CyBr + Cy_2$ would not take place; indeed, the author was totally unable to prepare the brom- or iodide cyanide corresponding to the salts just mentioned.

On an Aspirator, by Dr. Andrews, F.R.S., and *On another form of Aspirator*, by Prof. Delffs, could not well be understood without drawings.

SECTION C—Geology

The Geological Structure of the Tyrone Coal-field.—Mr. Hardman, after describing the position of these beds, remarked that the carboniferous rocks of this district appear to resemble somewhat those of the northern counties of England. The coal-bearing beds are true coal measures. The underlying limestone is split up by numerous sedimentary beds, and, on the whole, agrees with the Ballycastle coal-field, which beds Prof. Hull assigns to the same horizon with those of the Scotch coal measures. The author referred in detail to the thickness and position of the beds. With reference to the Dungannon coal-field, which extends from near Dungannon to beyond Coalisland, he remarked that though small in area it was rich in coal seams, possessing twenty-four coal-beds, of which at least thirteen were workable. They are highly bituminous, and two of the beds contain valuable seams of cannel coal. The chemical analyses show that these coals are valuable, possessing from 37·5 to 47 per cent. of volatile matter for gas manufacture. In the upper measures we have valuable deposits of fire-clay, which are extensively used for the manufacture of bricks and tiles. The ironstones are not sufficiently abundant to be worked, yet they yield as much as 21·7 to 35·5 per cent. of metallic iron. There must be from 30,000,000 to 40,000,000 tons of coal yet untouched. If we count the smaller beds we shall have at least 9,000,000 more. The coal-field is bounded on the north-west by a large fault, which brings down the coal measures on the south against the calp and lower limestone. It must have a downward throw of 2,000 feet. Northwards, the limestone is covered by trias, without any intervening coal measures, for three-and-a-half miles, when a small trough of the middle coal measures, with four of the upper Coalisland beds, rise up. This field is but two-and-a-half miles long, and a quarter wide, and yet it must contain the whole series of the middle and lower coal measures, the millstone grit and Yoredale beds. Here, the author calculates, there are 800,000 tons of coal. The author proceeded to explain when and how the two coal-fields became isolated from each other; and why, in the immediate vicinity of these coal measures, the Permian rocks are found reposing directly on the limestone. At the close of the carboniferous period the rocks were forced into flexures, ranging east and west, owing to forces acting from the northwards, as Prof. Hull shows acted in England. Denudation following, we had a set of plains, or edges of limestone, and troughs of coal measures, all of which were overlapped by the Permian and Trias. On subsequent denudation and post-triassic faults occurring, some portions of the coal measures would be laid bare or saved beneath the newer formations. As the whole district is cut up by faults, and the rock exposures few, the evidences of these flexures are obscure.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Dr. Williams read a paper *On Specimens of Alga from Jersey.* The paper referred to the large number of species of marine algæ to be found at Jersey, and to the favourable position of the island for their development. Dr. Williams produced a splendid collection of algæ preserved by a lady residing in Dublin.

Prof. Lawson read a paper *On certain peculiarities in the Indian Ampelideæ.* He remarked that many of the species were climbers, with their branches interlacing in the tops of the highest trees. In the stems of all were to be found numerous very large ducts, and these ducts were filled with intra-cellular vesicles, in which, at a certain time of year, abundance of starch was developed. He also remarked that in the fruit most important differences might be found, but that these afforded no means by which to divide the genus into natural sections. With respect to the inflorescence, he said there was great variety of form. Two species only reached the eastern coast of Africa, most being confined to India, though some few were common throughout the Malayan Archipelago.

On the Growth of Tree-ferns, by D. Moore.—The general conclusions arrived at in this paper were (1) Some of the kinds of tree-ferns grow with greater rapidity and form their stems in a much shorter period than is generally supposed to be the case; (2) After they attain a certain height the acrogenous buds are formed much closer together, one above the other, than they are lower down on the stem; hence their elongation is much slower; (3) Some of the sorts which at first form short rhizomatous stems before they take an upright position require a considerable number of years to perfect the early parts, but after the stem has been formed and an upright position taken, the growth is much quicker and the elongation advances rather rapidly compared with it, while the stem remains in a rhizomatous state.

Mosses of the North of Ireland, by S. A. Stewart.—Turner, in 1804, enumerated as Irish 230 species of mosses; Dr. Taylor, in 1836, mentions about the same number; and Dr. D. Moore, in 1872, gives a list of 385 Irish species, to which the author of the present paper adds four others, viz., 389, or more than two-thirds of the British mosses. Thus, relatively to the British Flora, Ireland has quite as large a proportion of mosses as she has of flowering plants, proving that Irish muscology has not been neglected. No separate lists of the mosses occurring in the northern counties have been published; but after consulting the records of Dr. Taylor in the "Flora Hibernica," and the valuable list of Irish mosses by Dr. Moore, also some detached papers on the subject, the author ascertains that the number of species occurring in the district amounts to 195, or more than one-half of the Irish mosses. The district is defined to consist of the counties of Down and Antrim, with a small portion of Co. Derry, bordering on Antrim. The list includes a large number of rare mosses. The following have not been previously recorded as Irish, viz.:—*Fissidens incurvis* Schw. var. *Lylei*, found only on a greensand rock on the Black Mountain, near Belfast; *Tayloria serrata*, in small quantity, near the summit of Benbradagh Mountain, Co Derry; *Mnium subglobosum*, in wet peat bog on Cave Hill, near Belfast, and in a similar habitat on Carrickfergus Common; *Seligeria calcarea*, on Black Mountain, near Belfast, appearing like black specks on small lumps of chalk in the grass. Mr. C. P. Hobkirk, of Huddersfield, has been kind enough to identify the specimens of the above-named mosses.

Prof. Dickson exhibited specimens of an abnormal form of the ox-eye daisy (*Chrysanthemum leucanthemum*), in which the outer florets of the ray (normally ligulate and female) exhibit an irregularly tubular corolla, not very unlike that in the neuter florets in certain Centaureas. Structurally these abnormal florets are hermaphrodite, but appear always to be functionally neuter or sterile.

Mr. Bentham remarked that similarly abnormal tubular florets, structurally hermaphrodite, and functionally neuter, occur in certain varieties of *Chrysanthemum indicum* and *Dahlia.*

Mr. G. Bentham, F.R.S. read a report *On the recent progress and present state of Systematic Botany*, commencing with a summary sketch of the state of science in 1830, when the natural method of Jussieu was beginning to supersede the sexual system of Linnæus; of its progress from that year to 1859, when the study of the general affinities of plants had entirely superseded the classing them according to single organs; and of the great advance effected since 1859, owing to the explanation of affinities given by the adoption of the doctrine of evolution. After some notes on the language to be preferred, systematic works were then considered under the six several heads of *Ordines plantarum*, *Genera plantarum*, *Species plantarum*, Monographs, Floras, and miscellaneous descriptions. Under each head the particulars required were specified, the principal recent works glanced over, with a short mention of the chief desiderata now recommended to the attention of systematic botanists.

Prof. Thiselton Dyer referred to the paper as evidencing the labour necessary to acquire a proficiency in the knowledge of botany. Some people thought botanical study was a kind of pastime, but the paper just read proved the contrary.

Sir John Lubbock believed that *mutatis mutandis* a great deal of what Mr. Bentham said with regard to systematic botany would apply equally to zoology.

Prof. Dickson gave the results of his investigations on the embryogeny of *Tropæolum peregrinum* and *Tropæolum speciosum.* In these species the principal peculiarity consists in the constant penetration of the carpellary tissue by the extra-seminal root-process. In *Tropæolum majus* the extra-seminal root-process developed from the outer side of the base of the suspensor After perforating the seed-coat it becomes elongated, and finishes its course in the cavity of the seed-vessel. In rare cases, however, this process has been found to penetrate by its very extremity the carpellary tissue. In *Tropæolum peregrinum* the extra-seminal process penetrates the carpel after having run in the cavity of the seed-vessel half-way. In *Tropæolum speciosum* this process dips into the carpel immediately after emerging from the seed. Dr. Dickson remarked that some would be disposed to look upon the abnormality in *Tropæolum majus* and the normal form in *Tropæolum peregrinum* as forms representing what might be viewed as stages in the evolution of such a species as *Tropæolum speciosum* from some form analogous to *Tropæolum majus.* In regard to this, Dr. Dickson adversely criticised the Darwinian hypothesis, as, in his opinion, inapplicable to the case under consideration.

Mr. A. W. Bennett read a paper *On the form of pollen-grains in reference to the fertilisation of flowers.* He stated that although not unfrequently a common form of pollen-grain runs through a whole group of plants, yet more often the form is found to be adapted to the requirements of the species, and varies even within a small circle of affinity. In those plants which are fertilised by the agency of insects, there are three general modes in which the form of the grain is adapted for the purpose. We have, firstly—and this is by far the most common form—an elliptical grain, with three or more longitudinal furrows, as in *Ranunculus ficaria*, *Aucuba japonica*, and *Bryonia dioica*; secondly, spherical or elliptical, and covered with spines, as in many Compositæ, Malvaceæ, and Cucurbitaceæ; and, thirdly, where they are attached together by threads or a viscid excretion, as in *Richardia Æthiopica.* In those plants, on the contrary, which are fertilised by the agency of the wind, as most grasses, the hazel, and *Populus balsamifera*, the pollen is almost perfectly spherical and unfurnished with any furrows, and is generally, moreover, very light and dry. The genus Viola supplies two very markedly different forms, in one of which, the section to which *V. canina* and *V. odorata* belong, the grains have the ordinary elliptical three-furrowed form, and where every point of the structure of the style and stigma is favourable to fertilisation by bees; the other, the section to which *V. tricolor* belongs, where they are very much larger and either pentagonal or hexagonal, and the style and stigma are adapted for fertilisation by Thrips. In all Crucifers hitherto known the pollen has the most common form. *Pringlea antiscorbutica*, the "Kerguelen's Land cabbage," has been shown by Dr. Hooker to be wind-fertilised, from the following considerations: the absence of petals, the absence of honey-glands, the exserted style, and the stigma being covered with long papillæ. The form of the pollen supports the same view, being very small and perfectly spherical, extremely different therefore from every other plant of the order. In the cowslip and primrose there is a uniform difference in size between the pollen belonging to the two dimorphic forms, that of the short-styled being always considerably larger than that of the long-styled form. An interesting discussion followed, in which Dr. Hooker, Prof. Dickson, Sir J. Lubbock, Prof. Balfour, and Mr. W. E. Hart took part.

SCIENTIFIC SERIALS

Memorie della Societa degli Spettroscopisti Italiani, June.—This number contains a very interesting account of the theories of the cause of formation of comets' tails, by Schiaparelli. The author seems to have no doubt that a repulsive force is in action, and that the only two acceptable theories are that the force is due to electricity or the repulsive power of the sun's heat.—Tacchini contributes a note on the polarisation of the zodiacal light, in which he corroborates Wright's observations of polarisation, and the presence of reflected sunlight. He also adds position observations of Coggia's comet in June.—Prof. Lorenzoni contributes a paper On some theoretical researches for a manner of rendering the whole of the solar chromosphere visible at once.

Bulletin de l'Académie Royale de Belgique, tome 37, No. 6.—This number contains an article by M. P. I. Van Beneden, On the whales of New Zealand. He refers to the fact that Dr. Gray of the British Museum has recognised three species in the New Zealand district, *Neobalæna marginata*, *Caperea antipodum*, and *Macleayius australiensis*, and urges that among the right whales there should be but one genus, *Balæna*. Those genera were established on imperfect data, and now that we have more material, several supposed diagnostics are found not to exist, and those that are established are of no great importance. As regards the skeleton at the Museum at Paris, studied by Prof. Lilljeborg, being without the ear-bone, that had been removed to be figured, and had not at the time been replaced. It is reported, however, as safe. Dr. Gray, believing that Van Beneden's drawing of the ear-bone was from some other source, erected it into a new genus.—MM. Cornet and Briart draw attention to some little known beds of phosphate of lime in the cretaceous beds of Hainault, and urge their being worked commercially.—M. Gluge gives a short note on tonic muscular contraction being converted into rhythmic contraction. His observations were on the sphincter ani muscles of rabbits, and he refers to similar experiments by M. Goltz on a dog. He believes that such experiments may lead to the explanation of the rhythmic contraction of the heart.

SOCIETIES AND ACADEMIES

Paris

Academy of Sciences, Sept. 14.—M. Bertrand in the chair.—The following papers were read:—Science before grammar, by M. E. Chevreul. A considerable portion of the paper (which is but an abstract of a more lengthy memoir) is devoted to a discussion of the word "*fact*." The author also draws a parallel between psychic and chemical analysis, the former separating simple ideas perceptible by the mind, and the latter ponderable simple substances perceptible by the senses. The difference between the moral and political sciences and the sciences of the domain of natural philosophy is pointed out, and in an appendix the author states his reasons for dissenting from scepticism and materialism.—On a particular toxic action exercised at a distance by *Colchicum autumnale* at the time of flowering; extract from a letter from M. La Pierre to M. Dumas. The hand, when held near the anthers of the flowers without coming into actual contact with them, changes in a few seconds to a livid greenish-yellow colour. The natural colour returns about ten seconds after the removal of the hand. The author believes that this remarkable action is chiefly exerted during or near the period of fertilisation, and proposes to examine further the nature of the substance emitted.—New conditions for the production of the silent electrical discharge; its influence on chemical reactions; by M. A. Boillot. The author concludes, from his experiments, that the space traversed by the silent discharge can be considerably augmented without a diminution in the chemical effects produced.—On some tungsten minerals from Meymac (Corrèze), fourth note, by M. Ad. Carnot. The minerals now described are wolfram (containing $FeWO_4$ and $MnWO_4$) calcareous scheelite (containing $CaWO_4$), and hydrated tunstic acid, to which the author assigns the formula $2WO_3, 5HO$, or $WO_3, 2HO$ (old notation).—On the supposed migration of winged *Phylloxera* to *Quercus coccifera*, by M. Balbiani. The author states his belief that the species seen by M. Lichtenstein on this tree is not identical with *Phylloxera vastatrix*. The following species of *Phylloxera* are recognised in addition to *vastatrix*:—*P. quercus*, especially inhabiting *Quercus pedunculata*, and *P. coccina*, inhabiting *Q. robur*. The species found by M. Lichtenstein on *Q. coccifera* it is proposed to name *P. lichtensteinii*.—Experiments on the employment of alkaline sulpho-carbonates for the destruction of *Phylloxera*; a letter from M. Mouillefer to M. Dumas.—On new points attacked by *Phylloxera* in Beaujolais; a letter from M. Rommier.—On the actual state of the invasion of *Phylloxera* in the Charente provinces; extract from a letter from M. Maurice Girard.—Employment of the water used in purifying gas for the destruction of *Phylloxera*; a letter from M. G. Beaume.—Note on the action exercised by the soil of vine fields on sulphuretted gases, and memoir On the propagation of *Phylloxera*, by M. Cauvy.—Other communications were received on the same subject from various authors, and M. Dumas gave a *résumé* of M. Balbiani's observations, and stated that in future the sending of living specimens of the insect to Paris would be interdicted.—The Minister of Foreign Affairs forwarded to the Academy a communication from the French Consul at Messina, relating to the opening of new vents of eruption in Etna, and on some earthquakes felt at Messina.—On a transformation of the equations of celestial mechanics, by M. Allégret.—On the causes which modify the setting of plaster, new cements with plaster and lime bases, by M. Ed. Landrin.—Action of heat on phenylxylene, by M. P. Barbier. The products are anthracene, benzene, and xylene, produced thus—

$$2C_{14}H_{14} = C_{14}H_{10} + C_6H_6 + C_8H_{10} + H_2.$$

—On a case of decomposition of chloral hydrate, by M. Tauret. By the slow oxidation of this substance, carbonic oxide is liberated. The author thinks this furnishes a new explanation of the action of chloral upon the system, and accounts for the accidents occasionally resulting from its use.—On the development of red vapours during the boiling of saccharine juices in manufacture, by M. E. J. Maumené. The author attributes these to the action of nitrates. On the *rôle* played by gas in the coagulation of the blood, by MM. E. Matthieu and V. Urbain.—Synthesis of purpurine, by M. F. de Lalande. This was effected by the action of oxidising agents on pure alizarine.—During the meeting, a communication was read from his Majesty the Emperor of Brazil, offering his thanks to the Academy for adding a young Brazilian astronomer to one of the Transit of Venus expeditions.

CONTENTS

PAGE
The Migration of Birds. By Prof. Alfred Newton, F.R.S. . . 415
Competitive Examinations 416
Meteorology in Mauritius. 418
Our Book Shelf 418
Letters to the Editor:—
  Fossils in Trap.—E. A. Wunsch 419
  Chrysomela Banksii.—H. Power 419
  Meteor.—G. H. Hopkins. 419
The International Congress of Orientalists 419
Common Wild Flowers considered in Relation to Insects, II. By Sir John Lubbock, Bart., F.R.S. (*With Illustrations*) . . . 420
Notes 426
Maritime Conference.—R. H. Scott, F.R.S 428
The British Association. Reports and Proceedings 430
Scientific Serials 434
Societies and Academies 434

THURSDAY, OCTOBER 1, 1874

HINTS ON MEDICAL STUDIES

FEW of those who to-day commence their medical education will be able fully to realise what would have been their position if they had done the same some fifty years or more ago, instead of now. After an apprenticeship of from three to five years to a country practitioner, during which time, at the expense of their general education, they would have been employed in dispensing medicines, and other less honourable duties, they would have entered on their medical studies, properly so called, possessing a certain empirical acquaintance with a few of the details of professional life, which might however, have been obtained in an infinitely shorter time after the principles of the subject had been mastered.

This state of things is fortunately past. The pupil now leaves school, having had a more liberal general training, conducted mostly during the time which used to be wasted in apprenticeship, and after being tested by a commencing examination in Latin, arithmetic, &c., he immediately begins his special studies at a recognised college and hospital. At the outset several questions respecting the direction that his work has to take, suggest themselves, which are only partially answered in the calendars of the different examining bodies, and on which there is considerable diversity of opinion amongst teachers and the profession generally. One of the most important of these refers to the question whether or not it is advisable to commence clinical work at once, or to wait until some knowledge of anatomy and physiology has been obtained. As the medical education consists of two parts, a theoretical and a practical, one conducted in the lecture-theatre and the dissecting-room, the other in the wards, out-patient department, and post-mortem theatre of the hospital: is it wise to pursue these two independent courses simultaneously, and if not, which should have the preference? This question is not difficult to answer, for it is evident that attendance in the wards of the hospital during the first medical session must very much resemble the justly disparaged period of apprenticeship. Like it, the knowledge acquired will be almost entirely empirical, and therefore so much the less useful; for the numerous facts which the student is learning from the classes he is attending at this early period, must for some time be so crudely associated in his mind that he will experience difficulty enough in retaining them there at all, let alone having to apply them to previously unexpected instances. We therefore would advise that the first winter session at least should be entirely devoted to lecture-work and the dissecting-room, and that the wards should not be systematically visited until the following summer. Then, even, as Materia Medica is not a winter subject, but little can be learnt with reference to treatment, except in surgery; experience in diagnosis must consequently be the only object kept in view. Afterwards, as much time as can be spared may be devoted to clinical work.

Another question which requires an answer refers to the number of subjects which ought to be embraced in the necessary course of study. Without wishing at present to enter into a discussion as to whether the vital force which is at work in the living body is anything *sui generis*, or only an elaboration of other well-known forces which are manifested by inorganic matter, there is no doubt that those physiological phenomena which are within the reach of complete human comprehension are all capable of being represented as problems of pure physics. Such being the case, the great importance to all thinking students of medicine, of a knowledge of the fundamental properties of matter, must be self-evident. Some may have had the opportunity of learning a little about mechanics, heat, light, and electricity at school, but most will be sadly ignorant on these subjects; and being so, when they have advanced sufficiently far in physiological and pathological investigation to appreciate the enormous fields for work which they open up, they will find no greater stumbling-block to their further progress than their imperfect training in the science of physics; it will act as a barrier against sound original work in all directions, and prevent many an able man from doing full justice to his mental capacities.

It is this unsoundness of the physical basis of physiology which maintains the considerable interval between physiologists and physicists; which makes it necessary to have physiological and physical laboratories as separate institutions instead of as different departments of the same establishment, and which allows flagrant physical inaccuracies in physiological investigations to be stated and restated under the approving sanction of those who ought to know better. What can horrify a pure physicist so much at the present state of physiological knowledge as, when he reads in a recently published work by one who is considered to be the British representative of the subject on which he treats, to learn that in the flight of birds the wings strike downwards and forwards; and in another work, by another prominent author, that the aortic valves, which correspond to the secondary valve of an ordinary pump, close *during* the contraction of the ventricles of the heart? Similarly, the phenomena of electrotonus, in the eyes of a physicist, have as little to do with the true nerve-current as the spark obtained from a Leyden jar has with that circulating in an ordinary electric telegraph cable. These instances, and many others which might be adduced, all point to the importance of a thorough knowledge of physics to the student of medicine.

Second only to physics, as a collateral part of medical education, is zoology. Many, however, would place botany next. No doubt a knowledge of botany is essential to a thorough comprehension of the details of Materia Medica; nevertheless, for the prosecution of work bearing on medicine proper, an acquaintance with the structure of animals is more important than that of plants. The latter may, most of it, be left to the pharmaceutical chemist, and be neglected by the physician. Very little is gained by the medical student when he learns that podophyllin is obtained from the rhizome of a ranunculaceous plant, or even that the natural order Solanaceæ has been divided up in a manner which physiological action justifies: but that the cæcum of the intestine is absent in many mammalia, and that it is of very much larger proportionate size in some than in man, must have an important bearing on our conception of the function of that organ. Many other similar instances might be given, all proving the importance of comparative anatomy in a medical point of view; and it is almost certain that before long that science will have a more prominent position in medical education than it at the present time possesses.

Those who have no other aspirations than to follow the routine practice of their profession immediately their few years of education are completed, will no doubt ignore the value of the extended curriculum we advocate: they imagine that it does not conduce to more accurate diagnosis or more correct treatment. This view is a short-sighted one, to say the least; for though the most able theorist may, by chance, be a bad practical physician or surgeon, yet the good he does by his higher work is insuperably greater in the long run than the immediate relief of individual cases. It is by the progress that is made by the profession in obtaining the mastery of disease that its position is maintained in society generally, and this progress is due much more to the theoretical chemist and physiologist than to the successful practitioner who simply follows the ordinary routine of his calling.

NOMENCLATURE OF DISEASES

Nomenclature of Diseases, prepared for the use of the Medical Officers of the United States Marine Hospital Service, by the Supervising Surgeon. (Washington: 1874).

THE preparation of this volume by Dr. Woodworth, supervising surgeon, has consisted in adopting, with some important omissions and unimportant transpositions, a literal transcript of the original "Nomenclature of Diseases" drawn up by a joint committee appointed by the Royal College of Physicians of London, of which Dr. Sibson was the editing secretary.

The original work received a modified sanction from the British Government, inasmuch as by the remarkable liberality of Mr. Lowe, then Chancellor of the Exchequer, money enough was provided to print off a large edition, and transmit a copy gratis to every member of the medical profession in Great Britain and Ireland. The further diffusion of the work in the United States by Dr. Woodworth is a thing for which the profession owes that gentleman hearty thanks. The work, indeed, seems to be more authoritative on that side of the Atlantic than on this; for the statistics of mortality for the ninth census of the United States were made up in accordance with its arrangement. This extension of a uniform nomenclature is itself, apart from the merits of the work, an evident great gain to science.

It is proposed to give the book a decennial revision; but while revision of some kind is periodically necessary, we do not anticipate that, after the work is thoroughly matured, it will be required above once in a generation,—three or four times in a century.

In the meantime, the book is in a somewhat imperfect state, many inaccuracies having been pointed out in a report upon it by the Edinburgh College of Physicians. The correction of such errors and the bringing of the work to the level of the present state of medical science will make it mature for the time being. But we hope that a new generation of medical men will find it necessary to revise it; not to correct common errors, but to adapt it to the then advanced state of medical science. We are doubtful as to the propriety of attempting work of this kind by a mixed committee. The committee should be of the only kind Dr. Chalmers could tolerate—a committee of one! only the one should have power to call in aid. The work of Linnæus or of Jussieu could not have been done by a committee.

A good nomenclature of diseases will inevitably represent the science of the day. According as science advances, so will the nomenclature and arrangement be more and more natural. The profession of medicine is to be congratulated on the felt want of a nomenclature temporarily fixed, and on the evidence this work affords of its generous ambition to rise above a mere nosology, to something like a natural pathological arrangement.

The wide diffusion of a book like this in the medical profession, besides its own immediate utility, is sure to exercise a very beneficial and much wanted scientific influence. The looseness of much professional writing will be diminished and precision encouraged. If medical terms are well defined, writers will naturally become more careful in their use of them. At present, medical writing is infested not only with ill-defined terms but indefinite description. How often do we see such phrases as "once or twice," when we should have "once" or "twice." We might give many examples of this looseness for which we tolerate no excuse; but there is a looseness arising from the imperfection of medical science which we must meantime tolerate. Good and precise definition of terms only becomes possible when we know the properties or peculiarities of what is to be defined, and medicine is as yet in too empirical a state for satisfactory definitions. That subdivision of it which is most advanced—pathological anatomy—illustrates well the growth of precision of terminology as advancing knowledge permits and demands it, definition and discovery going hand in hand.

The same branch of medicine affords the best illustration of an admirable struggle after a good nomenclature, but even for this branch there has not as yet arisen a Tournefort to produce, if not temporary unanimity, at least temporary union in regard to nomenclature—a deficiency which, however much to be deplored as a cause of confusion and error, implies blame to no one. If in morbid anatomy we have no established nomenclature, how can we expect it in the nosology? This department of medical nomenclature we regard as being meantime best left in what may be called its popular state, such names as scarlatina, erysipelas, cholera, thrush, being better than any that could be based on our present imperfect knowledge of these diseases. But although this may be so now, there is good reason to expect the day when good descriptive names will be found for all these diseases—names which will suggest to the instructed an epitome of what is known regarding them.

Such suggestive names cannot be, however, without a well-matured classification. At present there are several very natural but isolated classes of diseases which form good samples of what is wanted—zymotic diseases, parasitic diseases, mechanical injuries—but for the most part we have a disjointed catalogue rather than a classification. The attainment of a complete classification will be a great step, an index of progress and an aid to it; but it will be a structure, as we have already said, that advancing science will periodically overthrow. The ruin, however, will not be deplorable, because not only not irreparable, but certain to be succeeded by a new edifice which will in all probability be better and more useful than its predecessor. J. M. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Education of Women

IN your excellent article (vol. x. p. 395) on this subject, you forcibly point out that custom and prejudice have established for boys and girls a curriculum of studies which seems to have but little reason to justify it. You particularly mention that whereas music is, in England, but rarely taught to boys, it is "almost compulsory on girls, whether they have the talent for it or not."

This monopoly of music for girls, supposing our system of education to be founded on reason, should imply, amongst other considerations, that females possess peculiar aptitudes for this branch of art, and that instructing them in it is more likely to produce favourable results in their case than in that of males. I do not say that this is the only probable justification for our practice, but it should certainly be one strong ground for it.

But how does the matter really stand? It is a most remarkable fact that in the highest walk of musical achievement, composition, women are positively nowhere. I believe I am safe in saying that not a single opera, or oratorio, for instance, the work of a woman, has ever maintained even brief popularity; nor has the sex furnished us with one representative worthy of being placed by the side of Bach, Handel, Mozart, Beethoven, Rossini, Mendelssohn, and a host of other great male composers who could be named.

In almost every other department of art and knowledge eminent women have been found—in literature, both prose and poetic, in mathematics, science, painting, sculpture, medicine; but not a solitary great female musical composer can be named.

I do not point out this fact for the purpose of disparaging the female intellect, of which I have the highest admiration, but for the purpose of reinforcing with it the arguments put forward by yourself and other friends of female education in favour of a revision of the subjects appropriated by unreasoning custom to the two sexes.

Considering, however, that the doctrine of chances might have been expected to give us at least one female musician of the highest order out of the myriads who devote a large portion of their existence to the cultivation of the art, the striking fact that it is not so is one well calculated to excite speculation. Is the power of producing new and acceptable music distinguishable in any way from other art power—that for instance of producing a fine painting, statue, or poem? There does seem to me to be this peculiarity belonging to music. The subjects of a painting, statue, or poem, may, and generally are, suggested by some event, person, tradition, or thing already existing. The suggestions of colour, form, light, and shade, furnished by nature, are endless, and capable of infinite diversification—they often, no doubt, act on the mind of the artist unconsciously—but, whether he is conscious of it or not, their influence is always at work—and though he produces something which we feel to be truly original, yet he is probably indebted for the first germ of the idea and for the greater part of the machinery by means of which it has been realised, to sources and materials previously existing, some of which have indeed generally left their traces on the work.

Can anything like this be said of music? What can have suggested some of the simple melodies to which we are never tired of listening, and which are so complete, so consistent, so satisfying, that we accept them almost like works of nature which we do not dream of altering? That there are associations of ideas between musical sounds and visible things, and even moral sentiments, may be true, but such relations must be vagueness and mistiness itself, compared with the relations on which other arts are dependent. So slight, so remote, so intangible are the sources of original music, that it has always seemed to me that the faculty of musical composition of the highest order approaches more nearly to inspiration than any other faculty with which mankind is endowed.

How can the apparent absence of this faculty in women be explained? ALEX. STRANGE

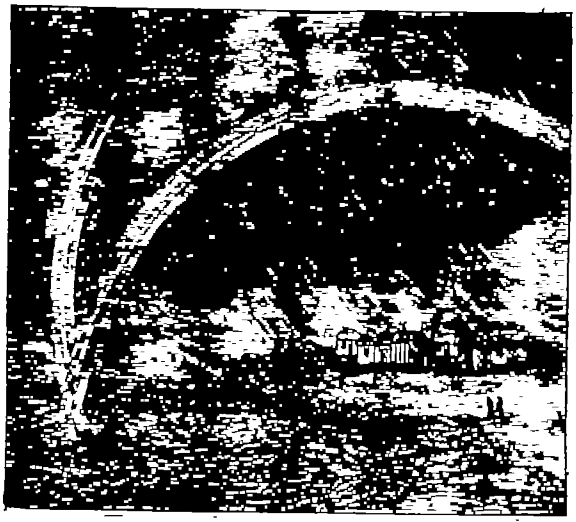
London, Sept. 22

Double Rainbow

ON the 11th, at 5.40 P.M., this comparatively rare phenomenon was well seen here by the crowd assembled at the Ladies' Golf Match. The accompanying sketch, by T. Hodge, Esq., gives a thoroughly artistic view of the scene.

Unfortunately the estuary of the Eden, whose quiet water furnished the reflected sunlight, is considerably north of the observer's station. Hence the necessary incompleteness of the second bow. I cannot learn whether any spectator was fortunate enough to observe the phenomenon from a point a mile or two north, whence it would probably have been seen entire.

As seen from stations to the eastward of St. Andrews, the second bow, there due to light reflected from the rougher water of the bay, was considerably broader than the first; so much so at the upper end of the visible portion as to give, even to intelligent spectators, the impression that it was convex instead of concave to the point opposite the reflected sun.



It was not possible to ascertain whether the light of the portions of the two bows visible below the horizon was that coming from the rain-drops directly, or that subsequently reflected from the sea; though (*pace* Dr. Tyndall) probably the latter was at least a considerable agent. P. G. TAIT

St. Andrews, N.B., Sept. 15

P.S. In my note on "Bright Meteors" (NATURE, vol. x. 305) I find I have inadvertently written Saturday in place of Sunday. Perhaps, with this correction, Mr. Waller may be able to identify both meteors in a satisfactory manner.

THIS is the phenomenon observed by Dr. Halley, Aug. 6, 1698, at Chester. The second bow was formed by the sun's light reflected from the river Dee. See "Brewster's Optics," p. 380.

Of the parts of the two bows below the horizon, the outer is a continuation of the primary bow, and is formed principally by direct sunlight striking the drops between the observer and the sea and reflected in the ordinary manner.

It may derive a slight increase of brightness from light first reflected at the sea, then by rain-drops, and lastly by the sea again. The inner part is produced by one reflection from the sea and one reflection from rain-drops. The brightness will be the same whichever reflection comes first, provided the smooth sea, the rain-drops, and the sunlight are present.

J. CLERK-MAXWELL

Curious Rainbow

I DO not see that the rainbow described by Mr. Swettenham (NATURE, vol. x. p. 398) was different from an ordinary rainbow of moderate brightness, except in there being a slight interval between the two series of colours, which generally blend into one another. The fainter series are attributed to interference. In bright rainbows there are three, if not four, series of colours, at least in the upper part of the arch, where the colours are always the most distinct, probably owing to the rain-drops being smaller high up, and therefore more perfectly globular. It may not be generally known that a rainbow may be seen much more perfectly in a single drop of dew, by placing the eye close to it, than in rain, and then no less than ten or twelve series of colours may be seen; and in the irregular dew-drops (as also in hoar-frost) a great and very beautiful variety of bows and spectra can be seen. T. W. BACKHOUSE

Sunderland, Sept 23

I SHOULD like to say a few words regarding Mr. Swettenham's letter (NATURE, vol. x. p. 398). The mathematical theory of the rainbow has been worked out pretty completely. We must not look for it, however, in text-books, which generally give a very unsatisfactory account of the rainbow, but in the original memoirs, which sometimes are very difficult to find.

The appearance of coloured bands inside the primary rainbow is not at all of very rare occurrence; since my attention has been drawn to them by a casual observation, I have seen them repeatedly. Only a few weeks ago I saw distinctly three concentric bows, with all the colours inside the primary bow. These bows have been called supernumerary rainbows. The complete mathematical theory has been given by the Astronomer Royal in the *Philosophical Magazine*, and the theory has been verified by Mr. Miller. The cause of these coloured rings is the interference of two rays of light entering the rain-drop at different angles of incidence, but having the same deviation, and therefore leaving the rain-drop parallel to each other. It is clear that two such rays must exist for all deviations from the maximum to the deviation of ray of light having an angle of incidence of 90°.

In text-books no mention is ever made of these supernumerary rainbows, and this is the more to be regretted as the interference mentioned above is, I think, one of the principal causes of its formation.

Were the explanation given in text-books complete, we should not have in the rainbow such pure colours as we actually see, but the yellow would contain a great deal of red, and the green would be contaminated by a great quantity of red and yellow. As it is, however, the red, which would have the same deviation as the green and yellow rays, is destroyed, or nearly so, by interference, which, therefore, is the cause that the colours of the rainbow are nearly pure. What is called the violet of the rainbow is generally the violet mixed with the red of the next supernumerary rainbow. This is not the only instance that text-books contain incomplete accounts of phenomena which have been satisfactorily explained. ARTHUR SCHUSTER

Sunnyside, Upper Avenue Road

Mist Bows

ON Sept. 14 I was driving from the Lizard just after sunrise with Mr. Lugg of Manaccan. A thick mist covered the fields and moorland. The tops of the farm buildings and corn stacks and the church towers were visible above the sea of mist which, matted on the ground, gave the entire country the appearance of being covered with snow. About 6.30 A.M. the sun was bright on our right hand, and on the left we saw a halo of prismatic colours forming a distinct circle of rainbow at a little distance from and encircling the shadows of our heads, and only broken where the shadows of our bodies interposed. This appearance lasted for ten minutes, and our shadows with their attendant bow showed brightly against the mist background as we passed hedges and fields, and kept pace with us like "the mist raised from the plashy earth" by the hare in Wordsworth's poem,

> "That, glittering in the sun,
> Runs with her all the way wherever she doth run."

We afterwards opened a valley terminating in an extensive moor, when the mist appeared as a sea of prismatic colour extending to the horizon. About 7 A.M. we saw a perfect bow free from any prismatic colour, both ends of which terminated in the field immediately to our left.

My companion, who is constantly driving about this district in early morning, says he never before saw similar phenomena.

Lizard Signal Station, Sept. 16 HOWARD FOX

Carnivorous Plants—how to be obtained

IT is not unlikely that there may be a great demand for plants of the genus Drosera, and as I am in a neighbourhood where the supply of the *D. rotundifolia* and *D. intermedia* is inexhaustible, I shall be glad to send, through the post, plants of the same to any who are desirous of investigating their carnivorous habits; but to meet the necessary expenses of collecting and postage, six penny stamps must be enclosed in the application for each dozen plants. The applications of dealers in plants will not be attended to.

The *D. intermedia* is far more abundant than the *D. rotundifolia*, and will answer the purpose of investigators quite as well. A few words about the method of growth of these may not be out of place. Pure peat well soaked with water suits either kind, but while the *D. intermedia* flourishes with its roots beneath the surface of the water, *D. rotundifolia* grows best when it is from 3 in. to 4 in. above the surface; now and then it happens that it is found with its roots in the water, and then the hairs on the stalks of the leaves, which constitute one of the distinguishing features between these species, are much diminished, both in number and length.

The Liverpool naturalists will find a large supply of the *D. rotundifolia* on Oxton Common, and there they are most abundant in the corner nearest to Noctorum Farm. Thurstaston Hill is another locality in the same neighbourhood where this plant grows.

The *Pinguicula lusitanica* is not uncommon in the bogs of the New Forest, but I cannot promise specimens of this plant with the same certainty as I can those of the Droseræ. Applications for plants had better have the word *Drosera* written on the envelope, to prevent the delay which would arise from such letters being forwarded to me when away from the New Forest.

Bisterne Close, Burley, Hants G. H. HOPKINS

[Both species are moderately abundant, though small, in a peat-bog near Burnham Beeches, Bucks, about four miles from Slough.—ED.]

Automatism of Animals

PROF. HUXLEY'S most interesting address published in NATURE, vol. x. p. 362, seems to me to involve some difficulty, which I take the liberty to state, though well aware that I am stepping on slippery ground. I allude to this passage:—"Suppose I had a frog placed in my hand, and that I could make it, by turning my hand, perform this balancing movement. If the frog were a philosopher he might reason thus: 'I feel myself uncomfortable and slipping, and feeling myself uncomfortable I put my legs out to save myself. Knowing that I shall tumble if I do not put them further, I put them further still, and my volition brings about all these beautiful adjustments which result in my sitting safely.' But if the frog so reasoned he would be entirely mistaken, for the frog does the thing just as well when he has no reason, no sensation, no possibility of thought of any kind."

Now, does it unavoidably follow from the latter fact that this philosophising frog would be *entirely* mistaken? What I should venture to object is simply this:—Experiment shows, indeed, that very delicate combinations of muscular actions (as in swimming) are brought about by impressions upon the sensory nerves, even when, after ablation of the brain, there can be no longer any consciousness. But have not those combinations originally arisen during undisturbed consciousness, and therefore, perhaps, under the influence of consciousness, inscrutable as the relation of consciousness to corporeal phenomena is acknowledged to be? And even if the experiments alluded to should succeed with animal individuals which, before vivisection, never had executed the movements in question (and I was once assured by a distinguished physiologist that similar experiments do really succeed with rabbits deprived of part of brain soon after birth), yet those adjustments may be rather considered with regard to the great principle of inheritance, as it has been applied to instincts by Mr. Darwin and Mr. Spencer, and alluded to in Prof. Tyndall's address. Though now performed by animals without possibility of sensation and thought, those movements were adjusted to each other, and to impressions on sensory nerves in these animals' ancestors while in possession of consciousness.

Surely such questions will ever remain doubtful; yet I think it not unbecoming to state a view of them which seems to me to be in accordance with the present direction of biological theories. I. D. WETTERHAN

Frankfort-on-the-Maine, Sept. 20

Photographic Irradiation

I HOPE you will allow me space to correct a slight misunderstanding which has got into the present discussion on photographic irradiation. Mr. Crofts (NATURE, vol. x. p. 245) places my views in opposition to those of Lord Lindsay and Mr. Ranyard. Mr. Stillman (NATURE, vol. x. p. 381), who has given us such valuable information on the molecular condition of different preparations of collodion, also takes the same view. Now in reality Lord Lindsay's and Mr. Ranyard's views are not opposed to mine. I have simply attempted to prove that molecular reflection was *a cause* of photographic irradiation, not that it was *the only cause*, as I quite agree with Lord Lindsay and Mr. Ranyard, that the imperfections of the lens are also causes of photographic irradiation, and in NATURE, vol. x. p. 185, I pointed out one form of irradiation due to the lens. But the imperfection of the lens which is most fatal is that pointed out by Lord Lindsay and Mr. Ranyard, namely, the inability of the lens to bring all the rays to a focus, whether this results from the imperfections of the outside portion of the lens, or from imperfect achromatic* correction. No maker of lenses will tell you that any lens, far less that every lens which he puts out, is perfectly corrected for dispersion. Working with such an instrument, it is very clear that if we only allow an exposure sufficient to give an image on the part of the collodion where the great proportion of the rays are focused, then the photographic impression will give very nearly the true boundary line. But suppose we allow more light to pass through the lens, either by turning the camera to a brighter light or by giving a longer exposure, then it is clear that the unfocused rays which gave no impression when the exposure was short, will now impress themselves on the collodion, and thus the photographic impression will be extended beyond the true boundary line.

That there should be difference of results in experiments on photographic irradiation is quite to be expected, as there are so many variables in the experiments. The light, temperature, and condition of the collodion are all constantly changing, and the conditions under which the experimenters work, and the apparatus and chemicals used, are different for each experimenter; different results may therefore be expected. If the experimenter use a good lens, and employ only the central portion of it, the imperfection due to the lens may be small in quantity. But if his lens is imperfectly shaped and badly corrected for dispersion, and he uses the full aperture, the result will be very different. Again, if the experimenter work with different collodions, Mr. Stillman has shown that, altogether independent of the lens, a very slight change in the preparation of the collodion greatly alters the amount of irradiation. So far as I can at present judge, the imperfections of the lens and molecular reflection are not opponents, but allied enemies, which we must meet on the same field. JOHN AITKEN

Darroch, Falkirk, N.B.

Can Land-crabs Live under Water?

WHEN in Atchin, in Sumatra, during the second Dutch expedition, it occurred to me to put to experimental test a statement which I thought I had seen in some book or other—this book turns out to be Prof. Marshall's work on "Physiology"—to the effect that land-crabs are drowned when kept immersed in water.

On one occasion I kept one of these crabs under water for two hours, after which time it was as lively as ever; and on another day a larger specimen was kept submerged for exactly four hours, after the lapse of which time it was somewhat subdued, but by no means moribund.

Unfortunately the duration of my experiments was always limited by the necessities of ablution, as our largest receptacle for fluids was a small-sized Huntley and Palmer's biscuit-tin, which served as our only washing apparatus, as well as the laboratory—eventually a very leaky one—for my experiments, for a period of four months spent under an equatorial sun.

New University Club, Sept. 22 J. C. GALTON

---

* We here require some new word, or we must greatly extend our conception of achromatism, as we have here to deal with rays far beyond the limits of the sensitiveness of the eye; and the word achromatic, as applied to lenses for chemical purposes, is somewhat misleading. I may here offer two suggestions as to how the imperfect power of the lens to bring all the different rays to a focus may be partially corrected.—(1) By using a collodion which is as nearly as possible only sensitive to those rays which the lens can bring to a focus, or (2) by providing each lens used for making accurate observations with a screen, which shall stop back all the rays beyond the limits which the lens can focus.

Salivary Glands of Cockroach

I SEE in NATURE, vol. x. p. 381, a letter on the salivary glands of the cockroach, by Dr. W. Ainslie Hollis, in which he remarks:—

"As far as my experience carried me, the sacculi, the supposed reservoirs of the saliva, never contained naturally any liquid whatever, but on opening the thorax were invariably found to be collapsed and empty."

A few days ago I was observing some of these creatures. I examined several shortly after they were caught; in these the sacculi were empty, but others which I had kept alive in a cup with only a few drops of water for a day or two, had invariably the sacculi distended with liquid.

I will not attempt to explain these facts, but leave that to others more capable than myself. CHAS. WORKMAN

Belfast, Sept. 21

THE AUSTRIAN POLAR EXPEDITION

THE Vienna correspondent of the *Times* supplies some interesting details concerning this important expedition. Events have proved that there has not been an expedition better fitted out, as to ship, stores, or crew, than that in which this North Pole Expedition left Bremerhaven on June 13, 1872.

As to the crew of twenty-four men, it was composed of three naval officers, Lieutenants Weyprecht and Brosch and Ensign Orel; two engineers, and fifteen picked Dalmatian sailors; Lieut. Payer, of the Jägers, an Alpine Club man, with two Tyrolese mountaineers; Haller and Kletz, and the Hungarian Képesy as surgeon. It was thus calculated for land work not less than sea work, and events proved that the company had been well sorted.

The object of the expedition being to find a north-easterly passage towards the coast of Siberia, the expedition having arrived at Tromsoe, and having taken on board Capt. Carlsen as harpooner and ice-master, started on the 14th of July for the sea and the coast of Novaya Zemlya. At Novaya Zemlya they met the Norwegian yacht *Isbjorn*, in which Count Wilczek and Baron Sternberg, two of the chief promoters of the expedition, had come over from Spitzbergen to establish a store for them near Cape Nassau. They were for two years the last human beings they saw. The stores being laid in a cleft of the rocks inaccessible to the Polar bears, and the state of the ice looking more promising, the ships parted company on the 21st of August, the *Tegetthoff* going north, the *Isbjörn* south. The hope proved to be fallacious long before evening. The *Tegetthoff* was icebound, and never was got out again. The temperature sank, copious snowfalls cemented the loose ice-fields, and the *Tegetthoff* was surrounded by a solid mass of ice.

In this precarious state the ship lay for five months, the ice freezing together and bursting in turn, and so exposing it perpetually to fresh pressure. All was prepared for leaving the ship. The stores were brought on deck and a portion placed on the ice. This was the most trying time of the whole. Every moment the alarm was sounded and the signal given for leaving the ship. It was sufficient to wear out the strongest. In spite of this, meteorological and other observations were carried on. The strain on the mind told on the state of health in spite of all precautions, and scurvy and pulmonary affections set in.

All this time the ship was being driven in a north-easterly direction until, towards the end of January, 1873, 73 W. long. and 79 lat. were reached on *February* 25. The sun appeared again after five months on the horizon, and on the 25th the pressure of ice ceased. A massive wall had been formed round the ship, protecting it from further injury. The drifting was now to the north-west. Milder weather having set in, the hope revived of setting the ship free, and for five months the work went on. By dint of boring and blasting the fore part of the ship was made free, but to free the aft proved impossible, ice of 30 ft. thickness lying underneath.

Disheartened, the expedition had almost resigned itself to have to pass another winter in the same position, when, on the 31st of August, high land was seen in the north, some fourteen nautical miles off. The feeling at first of great joy at the unexpected discovery became soon a torture. To be so close and not to be able to get to that unknown land. At last, towards the end of October, the ship drifted to about three miles off one of the islands which lay before the main land, and there the ship froze in at the beginning of November, and lies still in 79° 51′ N. lat. and 58° 36′ W. long. Here the winter of 1873-74 was passed in comparative quiet.

During the time a series of highly interesting astronomical, meteorological, and magnetical observations were made. The Northern Lights were very numerous and magnificent—white, red, and green, with crowns, bands, and rays of great size and brilliancy. The needle was so disturbed that oscillation became the rule and steadiness the exception. The cold was more intense than the year before, there being 37° Réaumur below zero on the ship. But the supply of fresh bear's meat and the absence of that strain on the mind produced by constant danger kept the crew in better health. The reappearance of the sun on the 24th of February did the rest for all except Krisch, the engineer, who died of consumption on the 17th of March, and was buried in the newly discovered land, between two basalt columns; for the explorations had already begun.

A first expedition of Payer, the two Tyrolese, four sailors, and the only three dogs remaining started for the mainland, went up the promontories named Tegethoff and M'Clintock, 2,500 ft. high, and up the Nordenskjold Fjord, bordered by the large Souklar glacier. It was still very cold, 40° Réaumur. All was still white with snow and hoar-frost, making the symmetrical rock columns look like candied sugar.

The second expedition of thirty days started on the 24th of March. The temperature had risen, but snow-drifts, wet, and the breaking up of ice made the journey still more dangerous. Of course, before getting the map it will be impossible to form a clear image of the configuration of the country. The atmosphere over the ice being hazy, the only way for making observations was by going to the heights, and by these means a succession of points was established—Cape Koldewey, 80° 15′; Cape Frankfurt, 80° 25′; Cape Ritter, 80° 45′; Cape Kane, 81° 10′; and Cape Fligely, 82° 5′, all on the Austria Sound. The diminished stores and the short available time necessitated forced marches, so one-half of the party was left under a rocky eminence in 81° 38′, and Payer, Lieut. Orel, the sailor Zaninovich, and the three dogs started to cross Crown Prince Rudolf's Land. Undeterred by a dangerous accident, the expedition went on by a roundabout way to the coast, and along it again northward. The progress became more and more difficult and dangerous; it was all fresh ice, often not more than a few inches thick. From Cape Fligely, the most northerly point touched, another elevated point, named Cape Wien, was sighted in 83°, the most northerly point of the known earth. Then the journey back again was more dangerous than the advance, but on the 25th of April the ship was seen on the spot where it had been left.

After a few days' rest, very much wanted, a third expedition was made, again to the west—like the first—when a high mountain, Cape Brünn, 40 miles from the ship, opened out a view over the mountainous country, with the Humboldt Peak, about 5,000 ft. high, as its culminating point.

Already, in March, a council had been held, and the decision had been come to to abandon the ship and to try to make their way back on sledges and boats. On the 20th of May the colours were nailed to the masts of the ship, and the expedition started with three boats and as many large sledges. The exertions proved almost too much. The journey had to be made five times over, three times tugging at boats and sledges, then twice back again. The continual south wind driving the ice northward seemed to make all efforts to get south useless, and after eight months' toil it seemed as if nothing remained but to return to the ship and pass there another winter. In the second half of July, however, north winds set in with rain, loosening the ice, and breaking it up, until on the 13th of August the expedition got into free water. It was in the unusually high latitude of 77° 40′. Had it not been for this exceptionally favourable state of the ice, the impression is that the expedition would not have been able to return. Now there was the pulling for the land. The crew and officers, divided into two watches, took it in turn day and night, so that forty miles' progress was made daily. On the second day the mountain of Nowaja Saulja was sighted. There were still provisions for a fortnight. A portion was left on shore, and then the southern bays were searched for Russian fishermen. None were found at the Barents Islands; bad weather set in, the sea ran high, all were wet through and unable to pull. It was already settled that the White Sea was to be made if no ship was found up to the 28th. However, on the 29th, two fishermen were sighted in a boat belonging to the schooner *Nicolay*, which brought the expedition to Vardöe on the 2nd of September.

The new land, as far as discovered, is about the size of Spitzbergen, and consists of several large masses intersected by fjords and surrounded by islands. A large passage called the Austria Sound separates these masses and forks under 82° north latitude into a north-easterly arm, which could be followed up to Cape Pest in the furthest north. The mountains are dolomitic. Their middle elevation is from 2,000 to 3,000 feet, only towards the south they may rise up to 5,000. All the depressions between the summits are occupied by glaciers of gigantic size, as they only occur in arctic regions. The vegetation is much poorer than that of Greenland, Spitzbergen, or Novaya Zemlya, and in the south, except for Polar bears, it is devoid of animal life too. Several attempts were made to pass through the country, but they were found impossible, mountains barred the road, so progress was tried along the coast line, and the more the explorers penetrated north by west the more the temperature rose, and the coasts of Crown Prince Rudolf Land were found to be tenanted by myriads of birds, elks, &c., traces of bears, foxes, and hares appeared, and seals lay on the ice. In spite of the treacherous nature of the road, it was continued to 82° 5′, where, at Cape Fligely, a wide expanse of water only covered with ice of recent formation was seen. In spite of this the explorers think the open Polar sea a delusion. Without raising a theory about the possible connection of this new land with Gillis Land in the south-west, the opinion is that it bears out up to a certain point Petermann's assumption of an inner arctic archipelago.

The fact of the expedition having found *hares* in the newly discovered land seems significant of a channel, not invariably frozen in winter, between Franz-Joseph Land and Spitzbergen, since hares do not occur in the latter.

In Norway the members of the expedition were received with the greatest enthusiasm, at Hamburg they were welcomed like bringers of good tidings, and on their entry into Vienna they could not have received a greater ovation had they been the remnant of a conquering army. All this they have richly merited, and there can be no doubt that Lieutenants Payer and Weyprecht have won for themselves a place in the first rank of arctic explorers.

A second Austrian Arctic Exploring Expedition is being prepared at Vienna to start next summer. One half of the expedition will seek to advance to the north, under Lieut. Payer, by way of East Greenland, and the other half, under Count Wilczek, will proceed *viâ* Siberia. The object of the expedition is to ascertain if the newly-discovered Franz-Joseph Land is a continent or an island.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-third meeting of this Association, which commenced at Hartford, under the presidency of Dr. J. L. Le Conte, on Aug. 12, seems to have been a successful one. Apart from the regular growth in prosperity which is exhibited every year, there was the unusual accession of the chemists, who have resolved to make their science strongly represented, and there was the excitement and interest which attended an important change in the constitution of the Association. The nature of the change we have already indicated (vol. x. p. 382). There was an unusually large attendance of the most eminent American representatives of science. The Association meets at Detroit next year on the second Wednesday of August.

The president's address consisted chiefly of allusions to some of the principal scientific events of the year, and of a summary of the matters to come before the Association. At a later period of the meeting the retiring president gave his address, in which he reviewed the progress of scientific instruments and methods. We can only refer very briefly to some of the more important papers read.

In a paper *On the Periodicity of the Rainfall in the United States in Relation to the Periodicity of the Solar Spots*, by Prof. John Brocklesby, the author concludes from his investigations that in the United States there is a connection existing between rainfalls and variations in the sun-spot area; the rainfall rising above the mean when the sun-spot area is in excess and falling below it when it is deficient.

Differential Measurements of Solar Temperature, by Prof. S. P. Langley of Pittsburgh, Pa. After stating the aims of the Allegheny Observatory at Pittsburgh, and giving details of the work now carried on there, consisting largely of observations and photographs of the sun, Prof. Langley said that there is a very wide variation in both the heat and light, and probably also in the actinic force of different parts of the sun. The difference is due principally, but not wholly, to differences in atmospheric absorption. Prof. Henry observed that the image of a sun-spot is colder than the photosphere surrounding it. Secchi has shown that the heat of the sun diminishes as we approach its edge, and he thinks that there is a different temperature at the sun's equator and the poles. Prof. Langley gave details of his own experiments with a thermopile upon these points. He finds that the observation of Prof. Henry is correct. But comparing the image of the spot with the photosphere immediately surrounding it, he finds that the image of a spot not far from the centre is uniformly warmer than that of the edge. To get the full significance of this observation we must consider that the image of the same spot is at the same time darker and colder than the photosphere near the centre, and darker and warmer than the photosphere near the edge. A series of measurements of the heat from the centre to the edge were made.

It does not appear as the result of these experiments that there is so great a selective absorption of heat in the lower regions of the sun's atmosphere, that when rays come from the edge of the disc and pass through a greater proportional thickness of his atmosphere, the heat is filtered from them and the light allowed to go through. We find that the heat falls away so very rapidly towards the edge as to indicate a much greater thinness of the solar chromosphere than has been hitherto admitted. We appear to have been led to the conclusion that there is a local obscuration over the spot very remarkable both in degree and kind. Prof. Langley exhibited a photograph of a sun-spot that looked, he said, like a sketch of a crystallising substance; when, however, we consider the enormous areas involved, we find the analogies of crystallisation wholly fail us, and we may more probably account for the facts by a hypothesis of cyclonic action. He concluded by pointing out the great value of these studies in connection with investigations in terrestrial meteorology.

Distribution of the Poles of Nebulæ, by Prof. Cleveland Abbe, of Washington. The general problem attacked in the present paper is the question whether there are planes that have a definite relation to nebulæ.

It may in general be stated that the positions of planes of rotation among the nebulæ do not show any such uniformity as is the case with the solar system: on the contrary, they are at all possible angles with each other. But there is this remarkable feature: that their nodes cluster about a point in R.A. 12h. 45m. and declination 60° N., that point being the North Pole of the plane near which lie the majority of the so-called axes of rotation.

Cave Fauna of the Middle States, by Prof. A. S. Packard, jun., of Salem, Mass.—For about a month during the last part of April and early in May last, Prof. Packard was engaged with Mr. T. G. Sanborn in exploring the caves of Kentucky under the auspices of the Geological Survey of that State, Prof. Shaler accompanying Prof. Packard. They first examined the Mammoth Cave, and doubled the number of animals known to exist therein and in others adjoining. An exploration, with Prof. Shaler, of the Carter Caves in Grayson County, Ky., also revealed a rich fauna composed of twenty species. Prof. Packard also examined Wyandotte Cave alone, and found a wingless Procus and two species of Thysanura new to the cave. Several caves within sixteen miles of New Albany, Ind., at Bradford, were examined. Finally, a careful examination of Weyer's Cave, in Virginia, and the adjoining Cave of the Fountains revealed a fauna containing some twenty species, no life having been previously reported from those caves.

These results show a great uniformity in the distribution of life—more than would at first be expected, though these caves lie in a faunal region nearly identical as regards the external world, and the temperature of the caves is very constant. Still some notable differences occurred.

Change by Gradual Modification not the Universal Law, by Thomas Meehan, of Germantown, Penn.—After adducing many instances in support of the theory that new forms are often generated by "leaps," Mr. Meehan concludes with the following propositions:—1. Morphological changes in individual plants are not always by gradual modifications. 2. Variations from specific forms follow the same law. 3. Variations are often sudden and also of such decided character as to seem generic. 4. These sudden formations perpetuate themselves similarly in all respects to forms springing from gradual modifications. 5. Variations of similar character occur in widely separated localities. 6. Variations occur in communities of plants simultaneously by causes affecting nutrition, and perhaps by other causes. Mr. Meehan argues from these premises that new and widely distinct species may be suddenly evolved from pre-existing forms without the intervention of connecting links.

This paper provoked considerable discussion. Prof. Morse said that the impression seemed to prevail among a great many that Prof. Meehan's paper was an argument against Darwinism, while in reality, in whatever sense you look at it, it was a corroboration of the theory of evolution. Prof. C. V. Riley insisted that most of the circumstances cited by Prof. Meehan found their parallels in what were generally known to zoologists as well as botanists as "sports" or even "monstrosities," and that Mr. Darwin himself had instanced some of the most interesting cases.

Prof. Asa Gray remarked that he only wished to state in respect to variations occurring abruptly as they did, that those certainly were not the kind of things which Mr. Darwin would have regarded as in any way interfering with his view, and he did not think Mr. Meehan had rightly comprehended the statement to which he had called attention. "I think (pursued Prof. Gray) that the statement, whatever it is, taken in connection with the remark which Mr. Riley made, and which Mr. Darwin a good deal insists upon, viz., that he does not look to monstrosities for the introduction of new forms, because the monstrosities may be expected to be taken out of relation to the surrounding circumstances, and that it is only those modifications which are in relation to surrounding and changing circumstances that can be utilised and turned to account—is not to be found fault with. Mr. Darwin distinctly notes that monstrosities may be hereditary, and so may be supposed even to be continued if they were sufficient in relation to surrounding circumstances. So, if Mr. Darwin readily takes into his view changes like that which everyone calls monstrosities, he may readily be expected not to regard it as any infringement upon the maxim that varieties should come into existence quite abruptly with considerable differences. I think it is true that varieties are apt to arise in that way with very considerable differences, and so true that those surely are not the kind of things to which Mr. Darwin looks as difficulties to overcome, but as stepping-stones in his way."

Glacial Phenomena in the Sierra Nevada, by Prof. John Muir, of Oakland, Cal.—The studies of Prof. Muir referred particularly to that portion of the Sierra which is embraced between lat. 36° 30′ and 39°, which measures about 200 miles in length by about 60 in width, and attains an elevation along the axis from 8,600 ft. to nearly 15,000 ft. above the sea. All the individual mountains distributed over this vast area, of whatever kind, have been brought into relief during the glacial epoch by the direct mechanical action of the ice-sheet and the glaciers into which it afterwards separated. The chief phenomena presented are:—(1) scratched and polished surfaces, (2) moraines, (3) moutonned rock-forms, and sculpture in general, as seen in valleys, ridges, lake basins, and separate mountains.

The paper goes on to describe the lofty mountains distributed along the summit of the portion of the Sierra under consideration, which are almost wholly unexplored—Mounts Dana, Lyell, Whitney, and Tyndall. The Pinnacles, which are the smallest of the summit mountainets, are described in an interesting way, the author concluding that instead of each being formed by special upheaval, or supposing that the chasms which separate them were made by subsidence, they were formed by the removal of the materials which once filled the intervening chasms. The same truth applies to the larger peaks, and the author concludes this branch of his subject by saying that they are all residual masses of the once solid wave of the entire range, and all that would be required to obliterate their distinctive character would be the restoration of the materials which have been carried away.

The next inquiry is, what has become of this material, not the millionth part of which can now be seen? and the author answers himself with the statement that glaciers were the transporting agents, and that in forming the basins and valleys in which they flowed, they carved out the summit peaks. This is so important a proposition as to demand careful attention to its proof. This proof is brought forward in detail. Subsequently, granting this proposition to be true from the proof, the author is obliged to go on to show what force or forces have sharpened the crests, which bear no trace of glacial action, and which were probably always above its reach. Next is considered the formation of special groups of mountains, and the geological effects of shadows—in prolonging and intensifying the actions of portions of glaciers, as shown in moraines, lake basins, and in the difference in form and sculpture between the north and south sides of valleys and mountains; especially as to their effects in the segregation of mountain masses. Also as to the effect of physical structure upon surface features, and the cause of the absence of well-marked individuality in summit mountains.

Prof. F. W. Clarke, of the University of Cincinnati, read a paper *On the Molecular Volume of Water of Crystallisation.* He stated that, to the chemist, it is important to get at some distinguishing character between water of crystallisation and true water of hydration. This character may be found by a study of the molecular volumes of various hydrated compounds. If we determine the molecular volume of frozen water, that is ice, we shall find it to be 19·6. If that water unites to form a hydrate or a crystalline salt, contraction ensues, and by studying that contraction we get at curious results. In the case of water of crystallisation, Prof. Clarke has studied over thirty salts, and in every case the molecular volume of the water is about 14. With water of hydration no such regularity is found. Evidently, then, when water unites with an anhydrous salt from water of crystallisation, all the condensation which occurs is on the part of the water, the volume of the molecule of the salt itself remaining unchanged.

Prof. Clarke also read a paper *On the Molecular Heat of Similar Compounds.* Prof. Clarke said that it is commonly thought that similar compounds have equal molecular heat. This is only approximately true. In comparing about twenty series of similar compounds, Prof. Clarke finds that the molecular heat increases slightly with the molecular weight, though in a very different ratio. In comparing all the extant determinations of specific heat, he has found only two or three exceptions to this rule, and even they were doubtful.

Prof. R. E. Rogers, of the University of Pennsylvania, read a *Notice of Prof. A. K. Eaton's new Compound One-prism Spectroscope.* The instrument is the invention of a Brooklyn chemist, and is by himself named "a direct-vision spectroscope." It consists of a thick plate of glass with parallel sides, united to one of the faces of an ordinary bisulphide of carbon prism, or a prism of dense flint-glass. According to the amount of dispersion desired, the light is made to enter either on the end of the glass plate or on the opposite face of the bisulphide prism. The results obtained from this instrument are as follows:—The dispersion of this compound prism is nearly four times greater than that of the ordinary 60° prism. The mean emergent ray is practically parallel to the incident ray. It does not deflect the ray from its original path. Many Fraunhofer lines are visible by this prism with the naked eye, while with the observing telescope all the prominent lines are clearly reversed, without the use of the slit or collimator, by merely throwing a strong beam of light by means of a mirror.

Dr. J. H. Mellichamp, of Bluffton, S.C., gave an account of some recent observations at Bluffton upon the *Sarracenia variolaris*, which abounds in that locality. This species of the pitcher plant has an elongated, conical, erect leaf, with a broad lamina curved over the opening, and a wide longitudinal wing upon one side the whole length of the tube. The upper portion is veined with purple, the intervening spaces being white and diaphanous. Dr. Mellichamp establishes the following points:—The base of the tube secretes a watery fluid, which is not sweet nor odorous, but which proves quickly fatal to all insects that fall into it. The whole inner surface is covered with very minute prickles, perfectly smooth and pointed downward, which render it impossible for an insect to ascend by walking, even when the leaf is laid nearly horizontal. Within the somewhat dilated rim of the tube there is a band half an inch in width, dotted with a sweet secretion, attractive to insects, but not intoxicating. This also extends downward along the edge of the outer wing to the very ground, thus alluring many creeping insects, and especially ants, to the more dangerous feeding-ground above, where, once losing foothold, it is impossible to regain it. Even flies escape but rarely, the form of the tube and lid seeming to effectually obstruct their flight. As the result, the tube becomes filled to the depth of some inches with a mass of decaying ants, flies, hornets, and other insects. Within this there is always found a white grub feeding upon the material thus gathered, perhaps the larva of a large fly which has been observed to stand upon the edge of the tube and drop an egg within it. Soon after the full development of the leaf the upper portion becomes brown and shrivelled, which is due to still another larva, the young of a small moth, which feeds upon the substance of the leaf, leaving only the outer epidermis, and works its way from above downward till in due time it spins its cocoon, suspending it by silken threads just above the surface of the insect *débris* at the bottom. The whole forms a series of relationships and an instance of contrivance and design, the full purport of which is still by no means fully understood. Other species of the genus, as also the allied Darlingtonia of California, manifest the same purpose of insect-capture, whatever the final object may be.

As complementary to Dr. Mellichamp's paper, Prof. C. V. Riley gave an account of his investigations on the insects more particularly associated with *Sarracenia variolaris*, which we shall reprint separately in an early number.

Number and Distribution of Fixed Stars is the title of a paper read by Prof. B. A. Gould, of Cambridge, Mass. The great work of Argelander undertook no less than a complete census of all stars in the northern hemisphere to the ninth magnitude inclusive, with as many as possible of the magnitude 9½. This was successfully executed, and an association comprising the great majority of northern observatories is now employing the working list thus obtained for the construction of a catalogue to fix star-places with the utmost attainable accuracy. The magnitudes are given to the tenth of a unit, from a number of observations on each, in the published catalogue, after having been first estimated by half units.

Prof. Littrow of Vienna made a careful enumeration of stars for each magnitude, to ascertain whether an approximate uniformity in the distribution of stars was indicated. If the magnitudes depend upon distances from us, and the stars are distributed with uniformity in space, the number of stars of any given magnitude should be proportioned to the spherical area within which they are observed. The truth of the hypothesis may be inferred from the degree of accordance between the numbers of stars of given magnitudes in the catalogue, and numbers computed from the contents of imaginary spherical shells whose radii would correspond with the respective magnitudes. An approximate indication might be obtained of the relative distances of each magnitude. Notwithstanding the difficulties which are incident to this method, due to inevitable errors of observation and comparison, Littrow believed that a sufficient degree of uniformity was demonstrated to justify faith in the general theory that there is a considerable degree of uniformity in the distances of the fixed stars within his investigation, and that there is warrant for applying his formulas—the results of his research—to regions outside of his limits. Discussing the numbers in Argelander's catalogue assorted by units as far as the eighth magnitude, he obtains the fraction 0·423 for the ratio of brilliancy between stars of two successive magnitudes; assorted by half units, the fraction is (including 8½) 0·431. Each computation gives the distance of a star of the eighth magnitude as 18, that of a star of average first magnitude being taken as a unit. The discordances between the results given by the empirical values of the formula and those from the enumeration of the catalogue are large, amounting to 39 per cent. for stars of the fourth, and 44 per cent. for stars of the ninth magnitude.

The recent completion of our Argentine Uranometry determines the actual magnitudes for all stars easily visible to the naked eye throughout the heavens. Prof. Gould thinks it improbable that the error of individual magnitudes exceeds the tenth of a unit. Prof. Heis has revised and extended Argelander's work to the nearest third of a unit for all stars visible in Central Europe with the naked eye, his lowest limit being 6½. The Argentine work furnishes similar data with respect to the stars in the southern hemisphere. Prof. Gould has carefully studied the results of Littrow's enumeration, is convinced of the accuracy of his computations, and accepts his formula as the best obtainable. Prof. Gould has extended a similar comparison to all the stars in the heavens of the sixth magnitude, using the numbers and magnitudes furnished by the uranometries, and obtains the value of the constant as 0·482. The accordance of this with observations may be judged from the following table :—

NUMBER OF FIXED STARS.

Magnitude.	Argelander. Count.	Argelander. Formula.	Uranometries. North'n.	Uranometries. South'n.	Whole Sky. Observ.	Whole Sky. Formula.
1	6	4	8	6	14	23
1½	4	4	7	4	11	16
2	22	8	25	20	45	29
2½	12	15	35	33	68	50
3	51	28	55	41	96	85
3½	60	53	103	87	190	149
4	128	99	132	108	240	257
4½	140	186	254	154	408	444
5	379	350	392	240	632	768
5½	463	658	696	563	1,259	1,329
6	1,242	1,236	1,374	1,075	2,449	2,300
6½	2,231	2,322	—	2,022	—	3,976
7	4,608	4,362	—	3,317	—	6,879
7½	6,878	8,197	—	—	—	11,900
8	14,525	15,402	—	—	—	20,582
8½	28,486	28,937	—	—	—	35,601
9	78,185	54,370	—	—	—	61,582

The columns under "Argelander" give the numbers obtained respectively by enumeration and by the formula thence deduced, from the *Durchmusterung*, and, of course, apply only to the northern hemisphere. The columns under "Uranometries" are deduced from Heis's *Atlas Cœlestis* for the northern sky and from the Argentine Uranometry for the southern. Under the "Whole Sky" the first contains the sum of northern and southern stars from the columns immediately preceding; the second the numbers computed on the hypothesis of uniform distribution in space and equal brilliancy. Comparing these numbers with those obtained from the *Durchmusterung*, the latter must of course be doubled.

The carefully determined numbers of bright stars from the Uranometry afford no greater support to the hypothesis than those obtained from the *Durchmusterung*. While a general similarity between the numbers of count and of theory is apparent, the accordance is sufficient to warrant deductions which are not essentially vague. Still the approximate accordance, as far as it goes, may furnish us with a constant magnitude ratio for crude estimates in cosmical inquiries.

If we assume, according to hypothesis, an equal number of stars in each hemisphere, there are altogether not less than 15,300 stars as bright as the seventh magnitude. But since the count indicates an excess of bright stars in the northern sky, there may be a thousand more, as given by the formula. The numbers of the *Durchmusterung* imply the existence of over 200,000 stars as bright as the ninth magnitude, though the magnitudes of faint stars in that work seem given on the average a little too bright. The average distance of ninth magnitude stars seems to exceed 25. The manifest agglomeration of faint stars in the Milky Way shows the inapplicability of the hypothesis to stars fainter than a certain magnitude. The limit of applicability is probably considerably beyond stars of the seventh magnitude or distances twelve times the average of first magnitude stars. There is no contradiction in all this to the well-known fact of accumulation of brighter stars in certain regions.

With regard to the belief that the number of stars of any given magnitude diminishes with their distance from the Milky Way, Prof. Gould says that in the clear atmosphere of Cordoba the existence of a bright stream of stars was very noticeable, including Canopus, Sirius, and Aldebaran, with the most brilliant ones in Carina, Columba, Canis Major, the Pleiades, &c., and skirting the Milky Way on its preceding side. On the opposite side of the galaxy the same was true, the bright stars fringing it in a stream that leaves it at Alpha and Beta Centauri, comprises the constellation Lupus and a great part of Scorpio, and extends onward through Ophiucus toward Lyra. Thus a great circle or zone of bright stars seems to gird the sky, intersecting with the Milky Way at the Southern Cross, but far more conspicuous on the other. The northern intersection of this zone Prof. Gould finds in Cassiopeia, which is diametrically opposite to the Southern Cross. The right ascension of the northern node is 0 h. 50 m.; the southern 12 h. 50 m.; the declination about 60°, and very near the points where the great circle of the Milky Way has its maximum declination. The inclination of this stream of stars to the Milky Way is about 25°; the Pleiades occupying a point just midway between the nodes. Prof. Gould after making this discovery found that it had been partially anticipated by Sir John Herschel, so far as the recognition of a portion of the zone was concerned. The two classes of considerations—the approximate method furnished by the hypothesis of an equable distribution of stars, and the existence of a well-marked zone of very bright stars as much inclined to the Milky Way as the equator is to the ecliptic, may assist in determining the position of our sun with reference to its own cluster, that of the cluster itself, and the scale of distances between its constituent stars.

Prof. Wright read two papers on cognate subjects, one *On the use of Natural Twin Crystals of Quartz in the construction of Polariscopes*, and *On the nature of the Zodiacal Light and the distribution of matter which occasions it.*—Prof. Wright gave reasons for doubting whether the hypothesis of bodies rotating around the sun in all directions, and within the orbit of the earth, will account for the zodiacal light. The observed form of the zodiacal light is consistent with the supposition that the reflecting bodies move in long orbits—*i.e.*, orbits of great eccentricity.

Small Brains in Tertiary Mammals.—Prof. Marsh compares the mammals of the Eocene, Miocene, and Pliocene, with the result that in the case of the animals observed, Dinoceras and Brontotherium, a very distinct and remarkable development of brain from the lower to the higher formations.

Summer Dormancy of Butterfly Larvæ, by Prof. C. V. Riley, of St. Louis.—In this paper the author, referring to Mr. S. H. Scudder's paper in the *American Naturalist* for Sept. 1873, gave the results of his observations on the larvæ of *Phyciodes nycteis*, some of which appear to remain in a dormant state through the summer and succeeding winter.

The Disintegration of Rocks, by Prof. T. Sterry Hunt, of Boston.—This subject the speaker had noticed briefly in a communication to the Association last year on the geology of the Blue Ridge. The change of the rocks in question is a chemical one, which is the most obvious in the case of crystalline rocks; the feldspar loses its alkalies and part of its silver, being changed into clay, and the hornblende its lime and magnesia, retaining its iron and peroxide. From this results a softening and decay, to greater or less depths, of the strata, so that while they still retain their arrangement, and are seen to be traversed by veins of quartz and metallic ores, the strata are often so much changed to depths of one hundred feet or more from the surface as to be readily removed by the action of the water.

Fog Signals and Transmission of Sound, by Prof. Joseph Henry, of Washington.—Prof. Henry does not exactly accept the deductions recently made by Prof. Tyndall, having himself observed a large number of similar phenomena, and attributing them to refraction, not absorption, of sound by wind and other causes. Prof. Henry found Tyndall's explanation, that a mixed atmosphere absorbed sound, inadequate to explain the facts. The practical interference, and therefore the practical absorption, must be very inconsiderable compared with the volume of sound. In the case of the syren, such is the intensity of the sound that it would cause sand to dance on a stretched membrane at a distance of one-and-a-half miles, while a 2500-pound bell would not set the same sand in motion at a distance of thirty yards.

It has been frequently observed that a distinct echo is sometimes obtained from the ocean. Prof. Tyndall thinks the reflection is from surfaces of wind. Prof. Henry thinks it is from the surface of the waves of the ocean, and that the sound is afterwards refracted by the wind.

In a paper *On the Tails of Comets*, Mr. Henry M. Parkhurst endeavours to give data for predicting the form and appearance of these appendages.

Thermo-electric Properties of Minerals, by Professors A. Schrauf and E. S. Dana.—The interesting investigations of the late Gustave Rose, an eminent mineralogist at Berlin, have, during two or three years past, excited considerable interest in this subject. He began with the fact first announced by Hankel that some crystals of pyrite and cobaltite are electrically positive and others negative, and the endeavour to explain this opposite character on the assumption that it was connected with a condition of the right and left hemihedrism characteristic of both species. This touches a fundamental point in molecular physics, and if it could be sustained, Rose's hypothesis would be very valuable.

Schrauf and Dana, however, after the examination of a large number of minerals, comprising nearly all the metallic sulphids, have come to the conclusion that the cause of the variation of electrical character in this species must be sought elsewhere. They attribute it not to an opposite molecular condition shown in the hemihedral crystals, but to a change in chemical composition. They call their attention, in the first place, to the series of Seebach, where, for example, platinum occupies a varying position according to its degree of purity; moreover, they urge that the single case observed by Stefan, where some specimens of granular galena are positive and others of crystallised galena negative, is strong evidence against the influence of hemihedrism, as nothing of the kind can be assumed here. The force of their argument lies in the fact that they have found several other well-defined cases of minerals having peculiar varieties, and that among minerals crystallising holohedrally. Chemical analyses were here desirable to show how far the material under investigation varied in composition. In the absence of these, however, the specific gravity was resorted to as an indicator of the chemical character.

This afforded decisive results of plus and minus varieties of species, showing a decided difference in density and implying a corresponding change in composition. This was true also, in a marked manner, of cobaltite, and in a somewat less degree of pyrite, showing in each case where the explanation for the electrical character was to be looked for.

Several other conclusions were deduced from the long list of observations contained in the paper, but the foregoing will be sufficient to indicate its principal points.

Distribution of American Woodlands, by Prof. Wm. H. Brewer, of New Haven.—The flora of the United States, the author said, is believed to contain over 800 woody species, and over 300 trees. Of these trees, about 250 species are somewhere tolerably abundant, about 120 species grow to a tolerably large size, 20 attain the height of 100 ft., 12 a height sometimes of over 200 ft., and a few—perhaps 5 or 6—a height of 300 ft.

Notes on Tree Growth, by Prof. Asa Gray, of Cambridge, Mass.—Whether the trunk of a tree increases in length, in the parts once formed, is still an open question in the popular mind. From careful observations made by Prof. Gray and many others, the conclusion is that the trunks of trees do not grow in length.

Natural History at Penikese, by Prof. F. W. Putnam.—In speaking of the method of teaching at Penikese School, Prof. Putnam said:—"Text-books are not allowed. Our way was to give each student a specimen of fish and ask him or her to study that fish and tell the instructor what had been observed. Thus we developed their powers of observation upon the external character of the fish. After they had studied the fishes for about two days, they were called upon to state what they had seen. Then the anatomy of the specimens was gone into, and the students were led on step by step until they had secured a very firmly founded idea of the structure of a vertebrate animal. Then we asked questions as to the character of vertebrates, and finally they began to be original investigators. We really demonstrated in a practical way the subject, which is exciting so much attention now, of co-education of the sexes. We found that the ladies of the school were as capable in every way of making careful dissections and rendering careful accounts of the work they had done as the gentlemen, and, in fact, four or five of the ladies became original investigators before any of the gentlemen. This showed conclusively that the ladies had the power of becoming original investigators in science if they only would give the application."

Organic Change produced in the Bee, by Sophie B. Herrick, of Baltimore.—This was a very interesting paper, containing the authoress's own observations and experiments on bees.

The Reversion of Thoroughbred Animals, by Prof. Wm. H. Brewer.—It is often claimed that if the care of man be withdrawn an improved breed will retrace the steps of its ancestry and revert to its original characteristics. For some years Prof. Brewer has been investigating this subject and seeking for proof of the alleged tendency to reversion. To carefully-worded inquiries in writing, following upon every report of such "reversion," Prof. Brewer has received very numerous replies, and they are unanimously in the negative. This is certainly remarkable, following upon the confident assertions that animals so frequently exhibited the alleged tendency. The inquiries were pushed in the specific localities where the reversion was said to have occurred; the questions have been put to a large number of stock-breeders, and finally have been made by means of a printed circular. But the result was always the same, except that a smile of incredulity extended over the faces of some stock-breeders when such inquiries were put to them, and they feared they were to be made the victims of a "sell." No instances of the alleged "reversion" having been authenticated in Prof. Brewer's experience, he asked the Association to aid in exposing and refuting the pernicious notion.

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"*

VII.—*Skull of the Snake* (Coluber natrix).

AMONG the most noticeable features of the Ophidian skull may be mentioned the ivory-like texture of the bones, the immense strength and compactness of the brain-case, and the equally remarkable mobility of the facial bones, the maxillary and palatine apparatuses and the lower jaw being arranged in such a way as to allow of the greatest possible extension of the mouth during deglutition. Another important characteristic is the bony completeness of the brain-case, which is as thoroughly closed in as that of a mammal, scarcely any part of its walls being formed in the adult either by cartilage or fibrous tissue; the inter-orbital septum, also, or laterally compressed anterior moiety of the basis cranii, so characteristic of the Sauropsida, is absent, the base of the skull being flat throughout, and abruptly terminated in front. But the most interesting and at the same time most anomalous feature is the persistence of the fœtal trabeculæ, in the form of two slender cartilaginous rods (Fig. 23, Tr), lying in grooves on either side of the parasphenoid.

The hinder part of the skull is formed by a well-ossified occipital segment, the four elements of which are firmly united with one another by suture; the single convex occipital condyle is borne chiefly by the basi-occipital, the exoccipital, however, taking a considerable share in its formation. The basi-occipital is continued forward by a broad, expanded, basi-sphenoid, produced anteriorly into a slender prolongation or rostrum (Fig. 22, Pa.S), which underlies the front half of the brain-case, and answers to the parasphenoid bone.

The parietals are completely fused together in the mid-line, where they are produced in the Pythons and Boas into a strong sagittal crest for the attachment of the temporal muscles. In their hinder half they are simply roofing bones, as in Lizards and Amphibia; but in front of the auditory capsule they extend downwards (Fig. 23, Pa^1) and meet the parasphenoid, forming with it a complete cylindrical cavity. The frontals, unlike the parietals, have only a sutural union with one another; but they, too, are produced downwards (Fr′), and, moreover, come into contact with one another below, above the parasphenoid, so as to form unaided the whole of the anterior third of the brain-case—roof, walls, and floor. There is yet another important feature in these curious bones—the cylindrical cavity which they enclose is divided in front by a double pillar of bone, to which each frontal contributes its own half, and on either side of which the olfactory nerves pass to the nasal sacs: in this way a remarkable resemblance, both in form and position, to the frog's "girdle-bone" is produced; an analogy, indeed, which only the study of development can show to be as far as possible from a true homology.

---

* Continued from p 430.

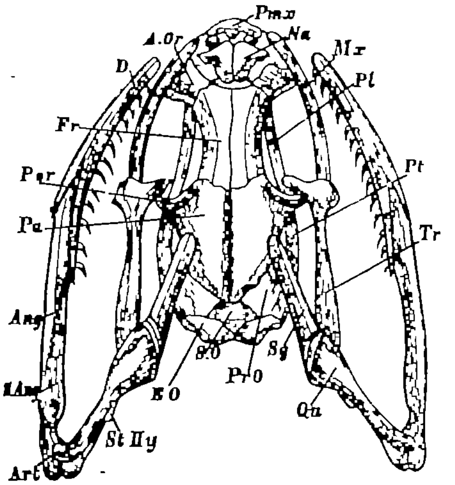


Fig. 21.—Skull of Snake (upper view). Tr, Os transversum

Interposed between the anterior border of the ex-occipital and the posterior border of the descending portion of the parietal, is a stout irregular bone, which anyone studying the adult skull only would certainly look upon as the periotic or ossified otic capsule. As a matter of fact, however, it is both more and less than this. In the young state it consists of two perfectly distinct ossifications, between which the fifth nerve makes its exit. Now, this nerve (see NATURE, vol. x., p. 10) marks the line of demarcation between the posterior boundary of the parietal segment and the auditory capsule; the bone in front of it is, therefore, the alisphenoid, and that behind it the prootic, the latter being further determined by the fact that it lodges the main part of the vestibule, of the anterior and horizontal canals, and of the rudimentary cochlea. The remaining elements of the ear-capsule are, in the adult, quite undistinguishable; it is seen, however, that the arch of the posterior canal, as far forward as its junction with the anterior, extends into what appears to be the supra-occipital, and that the ampulla of the posterior and the hinder portion of the horizontal canals invade, in like manner, the ex-occipital. The explanation of this seeming anomaly—so common in the Sauropsida—is to be found in the snake at the time of hatching, when the pro-, epi-, and opisthotic elements are perfectly distinct from the neighbouring bones as well as from one another: as growth proceeds the epiotic becomes firmly anchylosed with the supra-occipital, and the opisthotic with the ex-occipital: the prootic, at the same time, remaining separate from the bones with which it is naturally related, acquires an intimate connection with the alisphenoid, forming with it the seeming "periotic" of the adult snake.

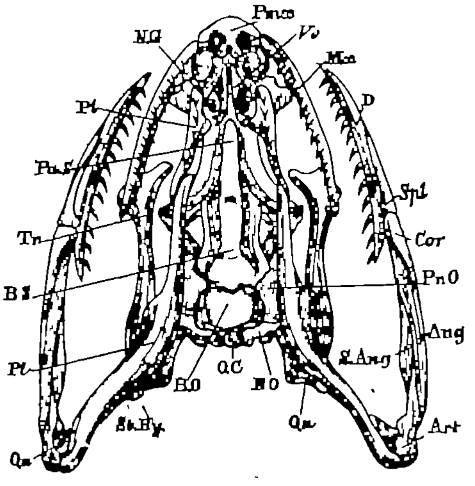


Fig. 22.—Skull of Snake (under view). Spl, splenial, Cor, coronary; Ang, angular; S.Ang, supra-angular.

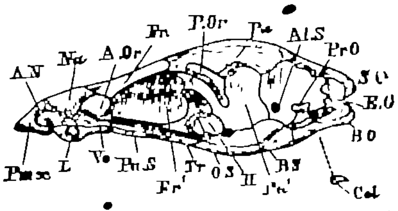


Fig. 23.—Skull of Snake (side view, with jaws removed). Col, columella, displaced from the fenestra ovalis, with which it is connected by a dotted line.

At the sides of the frontal region, and forming the anterior and posterior boundaries of the orbit, are two representatives of the "lateral line series" so prominent in osseous fish: these are the antorbital and the post-orbital. The antorbitals are large triangular bones, and between them lie the nasals, which together have a rhomboid form, and the inner edges of which are turned downwards, forming vertical plates similar to the inter-olfactory pillars of the frontals. In front of the nasals, and forming the termination of the snout, is the small toothless premaxilla, an azygos bone, with short nasal, maxillary, and palatine processes. The vomers are two hollow, scroll-shaped bones, bearing on their excavated upper surfaces the nasal glands; the ducts of these pass through a notch in the outer border of the vomers, which is converted into a foramen by means of a triangular ossification, the septo-maxillary, here attaining its greatest development. The duct of the nasal gland is also supported on the outer side by two labial cartilages (l).

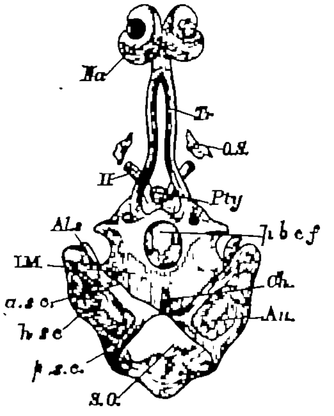


Fig. 24—Chondro-cranium of Embryo Snake (upper view) p.b.c f, posterior basi-cranial fontanelle.

The foregoing bones are all compactly united with one another; the remaining ones, forming the powerful manducatory apparatus of the upper and lower jaws, are articulated only by loose fibrous tissues, and are thus rendered capable of the greatest possible amount of extension.

On the upper surface of the skull, clamping the lateral occipital region and projecting backwards for fully half its length beyond the latter, is the flat sabre-like squamosal (Fig. 21, Sq), articulated to the hinder end of which, and thus carried completely away from the auditory region, is the quadrate, a stout bone passing obliquely downwards and outwards, and giving attachment by a rounded pulley-like surface to the mandible. On the inner edge of the quadrate, and partly coalesced with it, is a small nodular ossification representing the stylo-hyal (Figs. 21 and 22, St.Hy). The palatines and pterygoids are well developed and bear large recurved teeth; the latter extend backwards to the quadrate, to which they are united by ligaments just above its articular surface. The maxillæ are large strong bones lying parallel with the palatines and the front half of the pterygoids, and forming an outer dentigerous arch. Between the hinder end of the maxilla and the centre of the pterygoid runs a stout bone, the os transversum, found in this distinct form in all Ophidia, as well as in Lacertilia and Crocodilia, and occurring as a rudiment in some birds.

The two rami of the mandible are united at the symphysis by elastic fibrous tissue only, and each consists of six separate ossifications more or less fused together in the adult. These are the articular (Art) coming into relation with the quadrate, the angular (Ang) and supra-angular (S. Ang) applied, one above and one below, to the outer surface of the articular, the dentary (D) bearing the teeth, and the splenial (Spl) and coronary (Cor) appearing only on the inner surface.

The columella or auditory ossicle is extremely small in the common snake (Fig. 23, Col), and consists of a plug of bone fitting into the fenestra ovalis by a rounded disc-like end, the stapes, and of an extremely short rod anchylosed with and projecting backwards from the disc, which is all that represents the stapedial bones of the frog. In many of the larger serpents, both venomous and harmless, the columella is a rod of very considerable length, tipped at its end, in some cases, by an expanded cartilaginous flap, the homologue of the extra-stapedial.

The earlier stages in the development of the snake's skull have been well worked out by Rathke ("Entwickelungsgeschichte der Natter"). Abstracts of his views will be found in Prof. Huxley's Croonian Lecture (Proc. Roy. Soc., 1858), and in the "Elements of Comparative Anatomy" of the same author (p. 237). The earliest stage described by the lecturer corresponds with Rathke's third period, when chondrification is already thoroughly established, and the slender trabeculæ have united behind with the investing mass, and in front with each other (see Fig. 24). The notochord (Ch) reaches only to the middle of the broad investing mass (I.M), a large membranous space, the "posterior basi-cranial fontanelle" of Rathke (p.b.c.f) being between its anterior pointed end and the "anterior basi-cranial fontanelle," or pituitary space. A large occipital ring is already formed by the growing up of the investing mass around and above the neural canal, and articulating with its edges are the sub-triangular auditory capsules, on which the elevations caused by the semicircular canals (a.s.c, p.s.c, h.s.c) are particularly well marked. The trabeculæ diverge strongly in the pituitary region, in front of it run almost parallel, having between them the tissue from which the parasphenoid is afterwards formed, and eventually unite and expand into the large reniform roofs of the nasal sacs (Na). The alisphenoids (Al.s) are already chondrified, but the orbito-sphenoids (O.s) are backward in development, being mere patches of indifferent tissue in front of the exit of the optic nerve (II). The mandibular arch is completely divided into a short quadrate and a long Meckel's cartilage. The hyoid arch is cartilaginous only in its upper part, and its apex is already fused with the stapes.

In the second stage all the bones of the adult have appeared with the exception of the alisphenoid, orbito-sphenoid, columella, stylo-hyal, and otic bones. The basi-occipital arises in the same manner as the urostyle of a frog or osseous fish,* as a bony deposit in the sheath of the notochord, affecting subsequently the surrounding cartilage; the basi-sphenoid makes its appearance as a pair of ossific centres, one on each side of the apices of the trabeculæ, where they join the investing mass. The parietals and frontals are quite normal in their development, arising as symmetrical ossifications in the supero-lateral region of the membranous cranium, and only acquiring their anomalous adult character by downward extension towards the base of the skull at a later period. In this stage a segment has separated from the hyoid arch and attached itself to the inner border of the quadrate: this is the stylo-hyal, the remainder of the arch now constituting the columella.

In the third stage, consisting of snakes at the point of hatching, all the ossifications have appeared, with the exception of the orbito-sphenoid, which is unusually late and uncertain in its development. Besides the three chief otic centres, which are perfectly distinct from the occipital regions, a plate of bone is to be seen in this stage within the lower edge of the squamosal: this answers to the ectosteal plate of the pterotic, so largely developed in osseous fishes. Lastly, the jaws have acquired their adult character by the loosening of the quadrate from the auditory capsule and its retrogression to its adult position, articulating with the hinder end of the backward-turned squamosal.

NOTES

A MOVEMENT which has been for some time on foot for establishing in London a School of Medicine for Women is now so far matured that the school will be opened for the winter term on Oct. 12, in commodious premises, 30, Henrietta Street, Brunswick Square. The full staff of lecturers has not yet been appointed, but among those who have already consented to take part in the instruction are Dr. King Chambers in the practice of Medicine, Mr. Berkeley Hill in Surgery, Mr. A. T. Norton in Anatomy, Dr. Sturges in Materia Medica, Mrs. Garrett Anderson in Midwifery, Mr. Critchett in Ophthalmic Surgery, Dr. Cheadle in Pathology, Mr. Heaton in Chemistry, and Mr. A. W. Bennett in Botany. The following gentlemen have, in addition, consented to serve on the Council:—Dr. Billing, Dr. Buchanan, Mr. Ernest Hart, Prof. Huxley, Dr. Hughlings Jackson, Dr. Murie, Dr. F. Payne, Dr. W. S. Playfair, and Dr. Burdon-Sanderson, as well as Dr. Elizabeth Blackwell. A fair number of students are already enrolled. It is intended to build a detached dissecting-room in the garden attached to the house.

DR. WILLIAM RUTHERFORD has been appointed to the Professorship of Physiology at the University of Edinburgh, vacated by the resignation of Dr. J. Hughes Bennett. Dr. Rutherford, in accepting his new appointment, vacates the Professorship of Physiology at King's College, London, the Assistant-Physicianship at King's College Hospital, and the Fullerian Professorship at the Royal Institution. The duties of the first of these will most probably be undertaken, during the coming session at least, by Dr. David Ferrier.

DR. ADOLF BERNHARD MEYER, the recent explorer of New Guinea, has been appointed director of the Zoological Museum at Dresden, in succession to Dr. Reichenbach, who has retired.

---

* In these types a variable number of vertebræ at the termination of the column undergo a process of absorption, and a single ossification appearing in the sheath of the notochord constitutes the urostyle or coccyx. In the head a similar process takes place at the anterior end of the notochord, where a number of vertebræ may be considered to have been suppressed, forming what may be termed a "cephalostyle": the bony deposit spreading from this into the investing mass, gives rise to the basi-occipital.

Dr. Meyer entered upon his new duties on the first of last month.

A CORRESPONDENT with the Transit of Venus Expedition to Honolulu, writing from Valparaiso, informs us of the safe arrival there of the party after a particularly fine passage south; the weather was not so favourable up the Chili coast.

A LARGE and influential meeting of the professional and private friends of the late Dr. Anstie was held on the 23rd ultimo, at the house of Dr. George Johnson, in Savile Row, for the purpose of taking steps to raise a fund to be applied in perpetuation of Dr. Anstie's memory, and in recognition of his public and professional services. Dr. Burdon-Sanderson moved, and Dr. Glover seconded, a resolution—"That, considering the labours of the late Dr. Anstie for the promotion of science, and the circumstances of his untimely death, it is desirable that some permanent memorial of his career should be established." In speaking to this resolution, it was pointed out that Dr. Anstie's widow and three young children were but slenderly provided for, and hence that his only son would probably be unable to obtain the complete education which his father, if his life had been spared, had intended to secure for him. It was felt that the proposed memorial might fittingly take the form of a fund to be devoted to this object, and it was hoped that such an application of money might not be unacceptable to his family, and might be received by them as a fitting tribute to the estimation in which Dr. Anstie was held. By subsequent resolutions, a large committee was appointed to carry out the objects of the meeting, and Mr. J. S. Storr, of 26 King Street, Covent Garden, was appointed treasurer, and Mr. Brudenell Carter and Dr. Wharton Hood were appointed joint honorary secretaries. An executive committee was also nominated; and an opinion was expressed that the circumstances of Dr. Anstie's death, in the discharge of his duty, as well as much of the work which he had done during life to ameliorate the condition of the poor, were sufficient to justify an appeal to the general public as well as to his own profession.

THE Photographic Society invites scientific men who have turned their attention to photography to furnish specimens for their forthcoming exhibition. It is proposed to devote a room to the purely scientific applications of the subject.

WE would again draw the attention of secretaries of British scientific societies to the proposed work referred to in a recent number (NATURE, vol. x. p. 407) by M. Ranus, of the Belgian Academy—a Dictionary of Learned Societies. He is of course anxious to get full and trustworthy information, and we hope that the numerous societies of this country will lend him every assistance in carrying out his valuable scheme.

THE news of the death of M. Elie de Beaumont, in his 76th year, has thrown a gloom over the French Academy. We believe that his position of perpetual secretary to the Academy will be conferred on M. Bertrand, at present president of the Academy of Sciences. The *fauteuil* of M. Bertrand, who is a member in the section of Geometry, would thus become vacant, and would be the object of a warm contest. Since the foundation of the Academy of Sciences, the place of secretary has been permanent, while that of president has been annual. Among the predecessors of M. de Beaumont were Fontenelle, who died a centenarian after having occupied his *fauteuil* for sixty years, Condorcet, Fourrier, Delambre, and Arago, whom De Beaumont succeeded, the two together having held office for more than half a century. Since the death of Flourens, M. Dumas has been secretary for the Physical Sciences.

AT the Aberdeen Cryptogamic show referred to in last week's NATURE, p. 427, a meeting of botanists was held, when it was agreed to form a Scottish Cryptogamic Society, which, by an annual exhibition held in the larger cities by rotation, and by other means, would endeavour to promote a more general and deeper knowledge of cryptogamic plants. It is intended to hold the exhibition for next year at Perth.

THE first session of the Yorkshire College of Science, Leeds, opens on the 26th inst. There are already four professorships—Mathematics and Experimental Physics (Prof. Rucker), Chemistry (Prof. Thorpe), Geology and Mining (Prof. Green), Textile Fabrics (Prof. Walker).

THE expedition organised in June last by Captain Williams, of Sunderland, in the steamship *Diana*, belonging to Mr. Lamont, of Dundee, has returned to the latter port. The Novaya Zemlya region was the scene of the *Diana's* cruising; the Gulf of Obi was reached, and the conclusion come to that without difficulty a vessel might make Behring Strait. Capt. Wiggins, who was in command, endeavoured to assist the Austrian expedition, but was compelled to give up the attempt. Curiously, however, the *Diana* reached Hammerfest just an hour before the members of the Austrian expedition. Some important corrections of the geography of the region around the mouth of the Obi have been made.

THE council of the Institution of Civil Engineers have issued a list of subjects for premiums to be awarded during session 1874-75. Information with regard to the premiums, which are valuable, is prefixed to the list, and we advise those interested to apply to the secretary for information.

THE Council of the Institution of Naval Architects have had under consideration the question of providing a good series of contributions for their next session. They have accordingly prepared a list of subjects, which they desire to submit to the members and associates of the Institution, and others interested in shipbuilding, as questions on which they will be glad to receive communications for the annual general meeting in March (17th to 20th), 1875. Anyone wishing a list of the subjects should apply to the Secretary, 20, John Street, Adelphi.

THERE are several reports to hand of recent earthquakes. There was a violent shock at Randazza, Sicily, on Sept. 27, and several houses were injured. Rumbling noises are audible from Mount Etna.—Intelligence published at New York on Sept. 26 reports that the town of Antigua, in Guatemala, has been destroyed by an earthquake.—Several shocks of earthquake were felt at Delhi on Aug. 31, at 5.25 A.M.—A shock was felt near Sucklaspore, in the Madras Presidency, on the evening of the 17th Aug. The direction of the shock was from east to west, and the duration seven seconds.

A TERRIBLY destructive typhoon swept over Hong Kong about 12 o'clock on the night of Sept. 23. Many vessels were wrecked and the loss of life is estimated at 1,000, and the damage done to property is immense. The typhoon reached Macao, causing there also a fearful amount of damage.

ONE of the Limuli at the Crystal Palace Aquarium died last week from the effects of the continued attacks made on it by lobsters in the same tank. The other Limuli are now in a separate tank.

THE Swiss Society of Public Usefulness, says the *Continental Herald*, which met at Friburg from the 21st to the 23rd inst. inclusive, treated the subjects engaging its attention under two heads, viz., Public Instruction and Industry. Under the first head it discussed whether the professional teaching now given in the Confederacy should be altered; whether in the secondary schools for boys a larger share of scientific education ought not to be given, combined with practical exemplification, manual labour, and experience in industrial chemistry; whether in the secondary and superior schools for girls sufficient attention is paid to the class of studies which will be of service in careers now open to women, and if their education is directed towards facilitating their entry into new occupations; whether it would not be advisable to introduce into secondary schools for girls commercial education and the study of drawing as applied to manufactures, such as those of ribbons, lace, printed stuffs, wall papers, &c.

A NEW horticultural garden has been opened at St. Petersburg under Imperial patronage. It is fifteen acres in extent, and is to be devoted principally to illustrate how native plants may be combined for pretty and tasteful decorations. One large portion is to be devoted to conifers, in order that there may be, even in winter, green promenades.

THE consumption of osiers for various purposes, in England especially, is very great. Besides her own production, this country imports more than 5,000 tons, valued at about 40,000*l.* About 300 varieties of osiers are known, the most important beds being situated near Nottingham; the home produce being insufficient to meet the demands, great attention is being paid to the cultivation beds in Australia, and a considerable quantity is yearly produced in that country.

THE cultivation of the Angora Goat is attracting some attention in Australia, where this animal appears to thrive very well. The hair is said to make a very good "mohair" fabric, but its quality depends very much upon the nature of the locality in which the animals are reared. Undulating prairies with a good supply of pure water are best adapted to the habits of this goat. In sandy hilly districts it thrives admirably, but the hair is inferior and falls off very quickly. The flesh is excellent, and is preferred in some parts of Australia to the best mutton. The milk is of good quality and yields a good supply of butter and cheese. The hair is worth about four shillings a pound, and one ram will yield about four pounds at each shearing; the best plan is to shear them twice a year, as this prevents the hair from falling off and from splitting; at each shearing it is about six inches long. Compared with the merino sheep, the Angora goat seems to have the advantage in the fact that the former produces only three-and-a-half pounds of wool, worth two shillings and sixpence per pound, and that six merinos will eat as much as seven Angoras. These facts are important in view of the acclimatisation of the Angora goat in other parts of the world.

THE New Zealand Flax (*Phormium tenax*) is being cultivated in St. Helena, and there seems no reason why the same thing should not be done in other countries. Hitherto no very great attention has been paid to the cultivation of this plant, but the natural supplies obtained in New Zealand are insufficient for the demands of commerce. It is a mistake to suppose that an illimitable supply can always be obtained because no cultivation has been necessary in the first crops of the wild produce. This is not to be regretted, for careful cultivation cannot fail to greatly improve the fibre, and the best kinds alone will be worth the trouble of proper rearing. Steps are however being taken to cultivate the plant in New Zealand and in other countries which have been fortunate enough to acclimatise it. In the Azores, at St. Helena, in Algiers, and the south of France, it thrives well, and has been easily naturalised. The fibre is principally used for making ropes and paper, for the caulking of vessels, for stuffing mattresses, and for coarse textile fabrics. The seeds yield a valuable oil when crushed.

THE Crystal Palace Company are to give a magnificent fête on behalf of the Hospital Saturday Fund on the 5th inst.

M. HENRY COCKERILL, of Aix-la-Chapelle, nephew of the late John Cockerill, we learn from the *Journal of the Society of Arts*, who founded the great engineering establishment at Sering, near Liege, which until the immense extension of the Creusot works was the largest on the Continent, has placed at the disposition of the Société Cockerill the sum of 50,000 francs, to be invested in the public funds of Belgium, the interest to be applied to the endowment of scholarships, to enable the sons of workmen, or others employed by the society, to attend the courses of study at the Mining School of Liege.

THE popular demand in America for a complete series of the annual reports of the United States Geological Survey of the Territories, under the charge of Dr. F. V. Hayden, has been so great that the Secretary of the Interior has ordered the printing of a second edition of the first three annual reports in one volume: A compact 8vo. of 261 pp. with index has in consequence been issued. The survey in its present form commenced in the spring of 1867 with the small grant of $5,000 for the survey of Nebraska, and the following year a similar grant was made for Wyoming. During these two years the survey was under the General Land Office, and the first and second annual reports were included in the reports of the commissioner. Their reprint is a great convenience for reference. In the third year (1869) the survey was placed by Congress under the Secretary of the Interior, and $10,000 was granted for the examination of Colorado and New Mexico. The volume for that year was issued as an independent volume, and was reviewed in NATURE, vol. iv. p. 24. These reports differ from the memoirs of our English survey, which are in illustration of single sheets or sometimes quarter sheets of maps of the survey, for a United States Report includes a whole State. Our own enter into detail; these give general views. Further, these reports give not only the geological and palæontological features and mineral resources of a State, but its agricultural condition and prospects are included. Speaking of the treeless prairies, Dr. Hayden expresses his belief that forests may be restored in a short time, and gives many illustrations of what planters have effected in ten years in Nebraska. Cotton-wood (*Populus monilifera*), Soft Maple (*Acer rubrum*), Elm (*Ulmus americana*), Bass-wood or Linden (*Tilia americana*), Black Walnut (*Juglans nigra*), Honey Locust (*Gleditschia tricanthus*), and Willows, are the trees mostly cultivated. English agriculturists may perhaps be astonished at hearing crops being spoken of as promising because the grasshoppers have left a full half crop of wheat. In the first report are some interesting notes on the present condition of the Otoe Indians; and notes by Dr. Newberry and Prof. Heer, on the fossil leaves of the Dokata group; while the second report includes a sketch of the physical geography of the Missouri Valley. Although called a geological survey, climatal and meteorological observations are interspersed, as well as much information about game and wild animals. There is also much valuable agricultural information, that alone would create a large demand for the reprint.

WE have received the Eighth Annual Report of the Aëronautical Society. The report is mainly occupied with an account of experiments and calculations which have been recently made, and contains a paper by Mr. D. S. Brown on the Aeroplane, and a long and elaborate paper by Mr. James Armour, C.E., entitled "Wings for Man."

THE additions to the Zoological Society's Gardens during the past week include a Praslin Parrakeet (*Coracopsis barklyi*) and four Red-crowned Pigeons (*Erythrænas pulcherrima*) from the Seychelles, presented by the Hon. Sir Arthur Gordon; two Burchell's Bustards (*Eupodotis kori*) from S. Africa; a Hocheur Monkey (*Cercopithecus nictitans*) from W. Africa; a Punjaub Wild Sheep (*Ovis cycloceros*) from N. W. India; two Blackish Sternotheres (*Sternotherus subniger*) from the Seychelles; a Common Octopus (*Octopus vulgaris*) from the British Seas, deposited.

THE BRITISH ASSOCIATION

REPORTS

Tabular View of the Classification of the Labyrinthodonta, by L. C. Miall. Summary of the Second Report on Labyrinthodonta.

AMPHIBIA
LABYRINTHODONTA.

A.—*Centra of dorsal vertebræ discoidal.*[1]—Genera 1 to 25.

I.—EUGLYPTA. Cranial bones strongly sculptured. Lyra conspicuous. Mandible with well-developed post-articular process. Teeth conical; their internal structure complex; dentine much folded. Palato-vomerine tusks in series with small teeth. Short inner series of mandibular teeth. Sculptured thoracic plates, with reflected process upon the external border.

* *Palatine foramina large, approximated.*
† *Mandible with an internal articular buttress.*
‡ *Orbits central or posterior.*
1. Mastodonsaurus, Jäger.
2. Capitosaurus, Munst.
3. Pachygonia, Huxley (?).
4. Eurosaurus, D'Eichwald (?).
5. Trematosaurus, Braun.
6. Gonioglyptus, Huxley.
‡‡ *Orbits anterior.*
7. Metopias, Von Meyer.
8. Labyrinthodon, Owen.[2]
†† *Mandible without internal articular buttress.*
9. Diadetognathus, Miall.
** *Palatine foramina small, distant.*
10. Dasyceps, Huxley.
11. Anthracosaurus, Huxley.

II.—BRACHYOPIDA. Skull parabolic. Orbits oval, central or anterior. Post-articular process of mandible wanting (?).

12. Brachyops, Owen.
13. Micropholis, Huxley.
14. Rhinosaurus, Waldheim.
15. Bothriceps, Huxley.

III.—MALACOCYLA. Skull vaulted, triangular, with large postero-lateral expansions. Lyra consisting of two nearly straight longitudinal grooves, continued backwards as ridges. Orbits large, posterior, irregular. Temporal depressions, passing backwards from orbits. No post-articular process to mandible.[3]

* *Teeth with large anterior and posterior cutting edges.*
16. Loxomma, Huxley.
** *Teeth conical.*
17. Zygosaurus, D'Eichwald.

IV.—ATHROÖDONTA. Maxillary teeth wanting. Vomerine teeth aggregated. Orbit imperfect.

18. Batrachiderpeton, Hancock and Atthey.
19. Pteroplax, Hancock and Atthey.[4]

[V.—An uncharacterised group for the reception of some or all of the following genera.]

20. Pholidogaster, Huxley.
21. Ichthyerpeton, Huxley.
22. Pholiderpeton, Huxley.
23. Erpetocephalus, Huxley.

VI.—ARCHEGOSAURIA. *Von Meyer.* Vertebral column notochordal. Occipital condyles unossified.

24. Archegosaurus, Goldfuss.
25. Apateon,[5] Von Meyer.

B.—*Centra of dorsal vertebra elongate, contracted in the middle.*

VII.—HELEOTHREPTA. Skull triangular, with produced, tapering snout. Orbits central. Mandibular symphysis very long, about one-third of the length of the skull.

26. Lepterpeton, Huxley.

VIII.—NECTRIDEA. Epiotic cornua much produced. Superior and inferior processes of caudal vertebræ dilated at the extremities and pectinate.

27. Urocordylus, Huxley.
28. Keraterpeton, Huxley.

IX.—AISTOPODA. Limbs wanting.

29. Ophiderpeton, Huxley.
30. Dolichosoma, Huxley.

X.—MICROSAURIA, *Dawson.* Thoracic plates unknown. Ossification of limb-bones incomplete. Dentine non-plicate, pulp cavity large.

31. Dendrerpeton, Owen.
32. Hylonomus, Dawson.
33. Hylerpeton, Owen.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Photographic Operations connected with the coming Transit of Venus, by Captain Abney, R.E., F.R.A.S.

As is doubtless well known to all, there will be an application of photography to register the passage of Venus across the sun's disc, and it may not be amiss to give an outline of the processes, &c., that will be adopted. It has been determined by the Astronomer Royal that at every photographic station a photograph shall be taken every two minutes during the transit, and it has been a matter of considerable labour to work out a process that will admit of such a large number of negatives being taken in a hot climate. In Kerguelen's Land it would be perfectly feasible to adopt the ordinary wet process, the low temperature admitting of it, but in a temperature of 90° F. the evaporation of the volatile constituents of the collodion would render such a procedure inapplicable, as all practical photographers will admit. In India, where I have worked extensively, coating two or three plates in succession in a large-sized tent has sometimes proved injurious. With such experience I venture to think that it would have been madness to trust to the wet method for four hours, unless the conditions of *personnel* of the parties were considerably altered. Sir G. Airy, after much anxious deliberation, and with the advice (and that not hastily formed, by any means) of Mr. De la Rue, determined to adopt a dry process if practicable. After considerable experiments conducted at Chatham, it was determined to adopt an albumen dry process, using a highly bromised collodion, and strong alkaline development. There were several advantages in this:—(1) At the critical time the photographers would have nothing to distract their attention excepting placing the dry plates in the slide and developing every twelfth plate exposed, in order to regulate the exposure; (2) the irradiation was much diminished by the use of albumen, a point of no small importance when measurements have to be taken; (3) the shrinkage of the film is reduced to zero when the plates are properly prepared.

In regard to the first advantage claimed, it will be apparent that plates prepared at leisure will have a much superior advantage to those prepared in the hurry of the moment as would be the case with wet plates. The chances of stains and spots are diminished tenfold, and we may expect a much clearer picture.

The true explanation of irradiation has been argued of late in NATURE, and perhaps I may be pardoned for dwelling an instant on that point. Irradiation may be divided into two kinds, viz., that occurring from reflection from the back of the plate, and that occurring from reflection from the particles of bromide or iodide of silver in the collodion film. The first requires no explanation. If a film be insufficiently dense and of such a colour as will cut off the most active rays of the spectrum, no irradiation on that account need be anticipated. Iodide of silver fulfils this condition much more fully than does bromide of silver, the former approaching to a yellow colour, whilst the latter is almost white. A thin layer of iodide is much more efficient in cutting off the blue end of the spectrum than is the bromide; hence, if irradiation through reflection from the back of the plate is to be overcome, it is wise to use a certain proportion of iodide in the collodion. Practically I have found that in the dry process under consideration, three parts of iodide to two of bromide give the best results without diminishing the sensitiveness of the film. The second cause of irradiation, viz., reflection from the particles of bromide and iodide, is not hard to explain. When a colloid body such as gelatine or albumen is brought in contact with a soluble salt of silver, the resisting compound is found to be one which is singularly free from this defect. If a ray of light be allowed to fall at right angles upon a very thin cell containing an emulsion of bromide of silver, the cell having worked glass sides and ends, it will be found that the ray of light will be scattered considerably, apparently in a logarithmic curve; the surface nearest the source of light will not be affected, but it will spread from that surface towards the other, a physical line of light becoming an area. If, however, a colloidal salt of silver be introduced it will be found that this area is much diminished, and for small distances becomes inappreciable. In connection with this I may mention that bromide plates, even when backed with a non-actinic backing in optical contact with the plate, will give irradiation with alkaline development, whilst with acid development the irradiation will disappear. The explanation is not far to seek—the alkaline development reduces the silver *in situ*, the acid development deposits silver on the surface and where there is most attractive force. In the former case, the dispersed light acting on the interior of the film, causes the necessary change in the bromide of silver to effect reduction. Daguerreotype plates are not free from irradiation as has been supposed, though, owing to the extraordinary thinness of the iodide of silver, but little effect can be traced unless very prolonged exposure be given.

---

[1] This character is not of primary importance, but seems to be available for an arrangement determined by other considerations
[2] Orbits unknown
[3] Loxomma.
[4] The vomerine teeth are unknown, and this genus may therefore require to be removed.
[5] Of doubtful distinctness.

In the dry process selected for the transit of Venus it has then been thought desirable to have a rather dense film containing a proportion of iodide of silver and a colloid body—albumen—as preservative. I am not unmindful of the fact that different pyroxylines more or less affect irradiation, and we have altered the constitution of the pyroxyline in the collodion I shall use, by adding certain proportions of water; this materially aids the annihilation of irradiation from these plates.

For registering the time of external and internal contact of the planet with the sun's disc, the method known as Janssen's has been adopted, viz., causing a fresh portion of a plate to be exposed every second during the critical time, to the sun's limb, at that part where the contact will take place. Mr. Christie and Mr. De la Rue have both devised a slide for this purpose. The English parties use that designed by the former, whilst Colonel Tennant will use that by the latter. Shrinkage in the film has been carefully looked for by Dr. Vogel, of Berlin, and also by myself. Photographing a grating of 200 lines to the inch by contact printing, and measuring the results, I have been unable to find any alteration in the distances of the lines at any part of the film, hence I feel confident that any shrinking that can take place will be so small as to be negligible. The Russian parties are, I believe, going to use a grating material of iron wires. If shrinkage does occur this would be necessary, but it seems almost useless, in fact hurtful, where there will be none. There must be a certain error introduced due to the grating itself. The method of finding the angle of the position of the wires will be determined photographically. Two pictures of the sun will be taken at an interval of one minute on the same plate. The line forming the intersection of the sun's images will give the angle of position of the wires when measured by the micrometer. At each station the photographic party will consist of one officer and three sappers, all of whom have been trained in the use of the photo-heliograph and the process employed. A drill for each operation has been devised, and it is anticipated that the dangers of excitement during the critical times have been overcome by this arrangement. Practice on a mock transit has ensured a thorough knowledge of each phase of the phenomena; and I apprehend that discipline combined with a trust in their superiors will have annihilated one source of failure.

On the importance of improved methods of Registration of Wind on the Coast, with a notice of an Anemometer, designed by Mr. W. De la Rue, F.R.S., to furnish telegraphic information of the occurrence of strong winds, by Robert H. Scott, M.A., F.R.S.

It is hardly necessary to draw the attention of the Section to the fact that the configuration of the earth's surface exercises an overwhelming influence on the wind both as to its direction and force. Some statements and tables contained in a paper of mine in the last number of the *Quarterly Journal* of the Meteorological Society * abundantly prove this assertion, and it is therefore easy to see what an imperfect representation of the actual force of the wind at sea can be furnished by reports from a broken and mountainous coast, such as the Atlantic coasts of Ireland and Scotland, where the telegraphic stations are perforce situated in sheltered places, inasmuch as harbours are naturally found where there is as little exposure to wind as is possible.

In the practice of weather telegraphy and storm warnings, as the number of reports received per day from each station is strictly limited, on financial considerations, it is quite obvious that if the actual epoch of the commencement of a gale does not fall within the hours of attendance at the Telegraphic Office and at the Meteorological Office, which practically only extend from 8 A.M. till 3 P.M., much time will be lost in sending news of the fact to London. If it commences at 6 P.M. at Valencia, we cannot hear of it in London till 9 A.M. next morning.

On the other hand, if the observer be living in a sheltered spot, such as Plymouth, Nairn, or Greencastle, we shall not get a true report of the gale at all, inasmuch as the observer will not have felt it himself.

The first-named defect in our system can only be met by a considerably increased expenditure on the service, and that is not a scientific, but an administrative question, with which the Government can alone deal.

In order to meet the second difficulty, Mr. De la Rue has kindly devised an instrumental arrangement, by which the fact of any given force of wind having been reached at an exposed point (such as Rame Head for Plymouth, or Malin Head for Greencastle), can be at once conveyed to the reporter in his own office, or even to the central office in London. The instrument has been made by Messrs. Negretti and Zambra.

The following is the construction of the new signalling anemometer.

To the ordinary Robinson's anemometer spindle is affixed a toothed wheel, which is geared with another and larger toothed wheel fixed on a second vertical spindle which carries a centrifugal governor. The governor spindle is made to rotate at one-half or one-third of the velocity of the anemometer spindle in order that the rods carrying the governor balls may not have to be made inconveniently short. A provision is made for adjusting the length of the arms of the governors so that different wind velocities may be indicated within certain limits.

The governor balls act in the well-known way and expand when driven at a given rate, and the upward motion of these governor balls is used to raise a secondary wheel to bring into gear a third spindle on which is fixed the armature of a magneto-electric apparatus, which, like Sir Charles Wheatstone's instruments, consists of a compound permanent magnet with four soft iron cores, two of which are mounted on the north pole of the magnet and two on the south pole; these iron cores are surrounded with fine insulated copper wire, and on rotation of the armature give alternate + and — currents, in rapid succession according to the rate at which the armature is driven. These currents are conveyed inland to the observing station by insulated wires, and give warning by ringing an alarum as long as the anemometer cups are revolving at a velocity sufficient to raise the governor balls so as to bring the magneto-electrical apparatus into gear.

We see, therefore, that by adjusting the governors of the apparatus to indicate any required speed, a warning will at once be given when the wind reaches that speed, be it that of 60, 40, or 20 miles an hour, as may be required.

All the attention which the instrument requires after the apparatus is fixed is to lead two insulated wires from the anemometer into the observing station, and to connect these wires to the two terminals on the alarum.

In order to enable the observer to communicate at once and at as little expense as possible, to London, the fact of the velocity in question having been reached, the individual stations might be known by letters or symbols which might simply be telegraphed to London as an announcement that the alarum was acting at the station in question.

It is obvious that this plan is exceedingly simple, and there seems little reason why it should not be thoroughly efficacious, if only the registering portion of the apparatus can be properly protected from wilful damage by mischievous persons.

As usual, we are met by the question of cost, not only of the apparatus but of the connecting wires, and last, though not least, of the transmission of the messages. To enable us to render our service more effective than it is we must be supplied with the sinews of war. The 3,000*l*. which is the very utmost we spend annually on telegraphy, including salaries, rent, and every item, is but small compared with the 50,000*l*. *entirely exclusive of salaries* with which the chief signal office of the United States is so munificently endowed.

On the Source from which the Kinetic Energy is drawn which passes into Heat in the Movement of the Tides, by John Purser, M.R.I.A., Professor of Mathematics in the Queen's University.

Attention has of late years been directed by Mayer, Prof. James Thomson, and others, to the fact that the friction of the tidal currents on the bed of the ocean exercises an effect in retarding the earth's rotation on its axis.

The late eminent French astronomer, Delaunay, was the first, as far as I am aware, to form a numerical estimate of the possible magnitude of this effect, and to suggest that it furnishes a not improbable solution of that part of the secular inequality in the moon's mean motion which remains still unexplained.

---

* "An attempt to establish a Relation between the Velocity of the Wind and its Force (Beaufort Scale), with some remarks on Anemometrical observations in General," by Robert H. Scott, F.R.S. Quart. Journ. of Met. Soc. vol. ii. p. 109

He pointed out that inasmuch as the axis of the tidal spheroid is always behind the moon's place, a couple is exerted by the forces of the moon's attraction, which on the one hand retards the rotation of the earth, and on the other increases the dimensions of the lunar orbit.

This alteration of the lunar orbit prevents us from concluding, as we should otherwise do, that the kinetic energy which passes into heat in the movement of the tides has for its exact equivalent a corresponding quantity drawn from the store laid up in the earth's rotation on its axis.

The object of the present communication is to examine whether we can assert such an equivalence to hold approximately, and if so, to what degree of approximation. The question was started some years ago by the Astronomer Royal in the Astronomical Notices for the year 1866.

It occurred to the author that we might arrive at a solution of the problem from the information given us by the equation of energy combined with that of the conservation of angular momentum.

Let us in the first place take the case of a binary system consisting of the earth and moon, but suppose the plane of the earth's equator to coincide with that of the lunar orbit. If Q denote the energy which, during a given interval, passes into heat through tidal action, then, assuming the moon spherical and her rotation consequently unaltered, $Q = - \delta$ (energy of earth's rotation) $- \delta$ (energy of lunar orbit). By the energy of the lunar orbit is denoted the kinetic energy of the revolution of the earth and moon round their common centre of gravity, together with the potential energy of their separation.

Now the energy of orbit $=$ constant $- \frac{1}{2}\, m\, m^1\, \mu\, \frac{1}{a}$, where $m\, m^1$ represent the masses of the two bodies, μ the unit of attractive force, and a the mean distance.

Hence $Q = - \delta$ (energy of earth's rotation) $- \frac{1}{2}\, m\, m^1\, \mu\, \frac{\delta a}{a^2}$.

Let h denote the angular momentum of the revolution of the two bodies round their common centre of gravity, H the angular momentum of the earth's rotation, then

$$\delta H = - \delta h$$

but

$$h = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \sqrt{a} \sqrt{1 - e^2}$$

$$\therefore \delta h = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ \sqrt{1 - e^2}\, \frac{\delta a}{2\sqrt{a}} - \frac{\sqrt{a}\,.\, e\, \delta e}{\sqrt{1 - e^2}} \right\}$$

When the excentricity is small the second term in this expression may be shown to be negligible when compared with the first, and we may write

$$\delta H = - \delta h = - \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}}\, \frac{\delta a}{2\sqrt{a}}$$

$$\therefore Q = - \delta (\text{energy of earth's rotation}) + \frac{\sqrt{m + m^1}\,.\, \sqrt{\mu}}{Q^{\frac{3}{2}}}\, \delta H$$

Or if I denote the moment of inertia of the earth round her axis,

ω her angular velocity of rotation,

Ω the mean angular velocity of the moon in her orbit,

$$Q = - I \omega\, \delta \omega + I\, \Omega\, \delta \omega$$

$$\therefore - I \omega\, \delta \omega = \frac{Q}{1 - \frac{\Omega}{\omega}}$$

The left-hand member represents the loss of energy due to the slackening of the earth's rotation, and as Ω has the same sign as ω, we learn that not only is all the energy Q which is turned into heat in the motion of the tides drawn from the earth's rotation, but that, as a necessary concomitant, additional energy is transferred from the earth's rotation to the store at potential and actual energy, corresponding to the orbital motion of the system.

It also follows that when Ω is small compared to ω [in the actual case $\frac{\Omega}{\omega} = \frac{1}{27}$ nearly], the energy so transferred bears a very small ratio to Q, and that the energy lost in the earth's rotation is almost the exact equivalent of that consumed in tidal friction.

Let us now consider the case which we actually have to deal with, where the plane of the earth's equator does not coincide with the plane of the orbit.

Let G represent the resultant angular momentum of the system which will be fixed in magnitude and in direction.

θ, Θ the angles which the planes of h and H make with the plane of G.

Then, since $H^2 = G^2 + h^2 - 2\, G\, h \cos \theta$

$$H\, \delta H = (h - G \cos \theta)\, \delta h + G\, h \sin \theta\, \delta \theta$$

$$\therefore H\, \delta H = \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ (h - G \cos \theta) \frac{\delta a}{2\sqrt{a}} + G \sqrt{a} \sin \theta\, \delta \theta \right\}$$

$$\text{Or, } \delta H = \frac{m\, m^1 \sqrt{\mu}\, \sqrt{a}}{\sqrt{m + m^1}} \left\{ - \cos(\Theta + \theta)\, \frac{\delta a}{2a} + \sin(\Theta + \theta)\, \delta \theta \right\}$$

The author proves from a calculation of the disturbing reactionary forces exercised by the tidal protuberances that the variations $\delta \theta$ and $\frac{\delta a}{2a}$ are of the same order of magnitude, although their exact ratio cannot be determined without far more complete data respecting the tides than we at present possess.

Let the ratio of the first of these variations to the second be denoted by λ, then

$$\delta H = - \frac{m\, m^1 \sqrt{\mu}}{\sqrt{m + m^1}} \left\{ 1 - \lambda \tan(\Theta + \theta) \right\} \frac{\delta a}{2\sqrt{a}}$$

$$\therefore - I \omega\, \delta \omega = I \left\{ 1 - \frac{\Omega}{\omega}\, \frac{\sec(\Theta + \theta)}{1 - \lambda (\tan \Theta + \theta)} \right\}^{-1}$$

We may therefore still infer that since Ω is small compared to ω, the energy lost in the earth's rotation is almost the exact equivalent of that consumed in tidal friction.

The same conclusion manifestly applies to the work done by a tide-mill or any other mechanism in which the tides furnish the motive power.

It would further appear that as the mean value of $\tan(\Theta + \theta)$ is less than $\frac{1}{2}$, and that of λ cannot, on any probable hypothesis of the position of the tides, be supposed to exceed unity, the coefficient of $\frac{\Omega}{\omega}$ in the above expression is positive. Hence we may conclude that, as in the simpler case previously discussed, the small transfer of energy which accompanies the principal action takes place from the earth's rotation to the moon's orbit.

All these conclusions apply *mutatis mutandis* if we regard as our binary system the earth and sun.

In the case of nature, where we have to consider the three bodies acting together, the main conclusion that all the energy lost in tidal friction is drawn from the earth's rotation will not be invalidated.

Moreover, if we assume, as is generally done, that the friction varies as the velocity, the lesser effect, *i.e.* the concomitant, transfers its energy from the earth's rotation to the energy of the orbit of the moon about the earth, and that of the earth about the sun will correspond to the values separately calculated for the binary systems.

On the construction of large Nicol's Prisms, by W. Ladd.—In January 1869 I constructed two Nicol's prisms of about $2\frac{1}{4}$ in. aperture, which in the able hands of Mr. W. Spottiswoode and Dr. Tyndall have done much valuable work, and given rise to a great demand for such prisms, both in England and America; but as the length of a good Nicol should be about three times its diameter, very great difficulty is experienced in procuring pieces of spar of sufficient purity to give such a field.

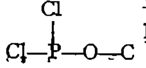
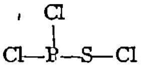
This has given rise to various methods of utilising the spar by building up prisms of shorter pieces and combining them in such a way as to unite their field of view, such as utilising four prisms of 1 in. aperture, thus giving an aperture of 2 in. Another plan I adopted was to unite two whose diameter in one direction was double that of the other; these, being balsamed together, made a very good prism; but lately I had a very good piece of spar that, but for one corner of the rhombus, which was bad, would have made a prism $3\frac{1}{2}$ in. aperture. This was, therefore, too valuable a piece to be put aside.

I therefore cut it at the proper angle, which took away all the bad portion; I then took another piece half the length of the first, but of the same diameter, and cut this also at the proper angle, and the bringing the two ends together gave me another complete half; these, having been balsamed together and united with the first half, produced a perfectly good prism. I may add that it is essential that the two or more pieces constituting the half prism should have their cleavage planes exactly parallel, or the image would be bent at their junction.

SECTION B—CHEMICAL SCIENCE

On the Specific Volumes of certain Liquids, by Prof. Thorpe.—Kopp found that the specific volumes of certain elements varied. Thus, the specific volume of oxygen "within the radicle" = 13·2, "without the radicle" = 7·8; of sulphur, "within the radicle" = 28·6, "without the radicle" = 22·6. "Within the radicle" was defined as meaning an instance where the oxygen or sulphur atom is united by *two* bonds to the binding element, while upon "without the radicle" it is united by only *one* bond. Kopp announced that members of the same chemical family have identical specific volumes. The author determined the specific volumes of vanadyl trichloride, $VOCl_3$, and phosphoryl trichloride, $POCl_3$, and found in the former case that the specific volume = 106·5, while in the latter it = 101·5. Kopp's law does not therefore hold in this instance. The following examples also show that as the atomic weight increases the specific volume also increases:—

$SiCl_4$ . . . . . specific volume = 121·1
$TiCl_4$ . . . . . " " = 125·1
$SnCl_4$ . . . . . " " = 132·4

Another of Kopp's deductions is that isomers have the same specific volume; but the author found a difference between the specific volumes of ethyl-amyl and heptane, both of which are expressed by the formula C_7H_{16}; in the former case the number was 162·25, while in the latter it was 157·34. The author also determined the specific volume of the compounds PCl_3 = 93·7, $POCl_3$ = 101·5, and $PSCl_3$ = 116·3. Now, 101·5 − 93·7 = 7·8; that is to say, the specific volume of oxygen in $POCl_3$, is 22·6, hence it is without the radicle, in this compound. So also 116·3 − 93·7 = 22·6; that is, the specific volume for sulphur "without the radicle." Hence the structural formulæ of these two substances $POCl_3$ and $PSCl_3$ will be  $\mathrm{Cl}-\overset{\overset{\mathrm{Cl}}{|}}{\mathrm{P}}-\mathrm{O}-\mathrm{C}$ and  $\mathrm{Cl}-\overset{\overset{\mathrm{Cl}}{|}}{\mathrm{P}}-\mathrm{S}-\mathrm{Cl}$ respectively; that is, in each case phosphorus is most probably a triad, not a pentad element.

On the Dissociation of Nitric Acid, by Messrs. Braham and Gatehouse.—Nitric acid when passed through an ordinary clay pipe at varying temperatures is split up: at the temperature of molten tin 2·10 per cent. is decomposed; at the temperature of molten lead 22 to 23 per cent. is decomposed; when the clay pipe is heated with gas 71·72 per cent. is decomposed, while when heated with charcoal 83·4 per cent. is decomposed. The gases evolved consist of oxygen, nitrogen, and nitrous oxide; the proportion of these gases it has been found very difficult to determine accurately. The following probably represents the reaction which takes place at minimum temperatures:—

$$8HNO_3 = 4NO_2 + 4H_2O + N_2O + N_2 + O_{11}.$$

When glass bulbs are partially filled with nitric acid and exposed to direct sunlight, the acid is decomposed, the amount varying with the time and intensity of the light; the decomposition is brought about by the violet end of the spectrum. If the bulbs are entirely filled with nitric acid, no decomposition ensues. After some time the decomposition ceases; this is due to the formation of nitrous acid, and if this is expelled by boiling, the decomposition again proceeds. If pure nitric acid be boiled, even to dryness, no decomposition takes place, but if the acid contains nitrous acid, then this latter is dissociated.

On the Replacement of Organic Matter by Siliceous Deposits in the process of Fossilisation, by Dr. Carpenter, F.R.S.—The author described several cases in which the internal casts of *Foraminifera* were found, consisting of silica, generally as silicate of iron. This process is now going on at the ordinary sea-bottom. Fragments of the spines of *Echinus*, which originally contained protoplasm, have been found, in which the organic matter has been entirely replaced by silica, thus forming exact siliceous models of the animal matter. In some cases the siliceous deposit has preserved the exact form of thin tubes less than 1-10000th of an inch in diameter. The author supposed that during the gradual decay of the animal matter there had occurred a simultaneous deposition or substitution of siliceous matter in its stead.

On the Silicified Rock of Lough Neagh, by Prof. Hodges.—The water of Lough Neagh was found to contain only 12·95 grains of solid water per gallon; of this, 10·6 grains consisted of mineral matter, while 2·35 grains of organic matter were present. Of the total mineral salts a very small quantity only—less than 1 grain per gallon—consisted of ferric oxide. Samples of petrified wood were also examined: these contained on an average about 87 per cent. of silica, and a very small percentage of iron.

On a Self-registering Apparatus for measuring the Chemical Intensity of Light, by Prof. Roscoe, F.R.S.—In this communication the author described his already well-known self-registering photo-chemical apparatus.

On certain Abnormal Chlorides, by Prof. Roscoe, F.R.S.—The author drew attention to some of the chlorides of vanadium, tungsten, uranium, and sulphur. The highest chlorides which we have been able to obtain of these elements generally do not correspond with the highest oxides; thus, although we know of the oxides V_2O_5, we know of no higher chloride than VCl_4, and even this chloride is easily decomposed into VCl_3 and free chlorine. Although the oxide of tungsten, WO_3 is stable, yet the corresponding chlorine WCl_6 is very ready to split up into WCl_5 and free chlorine. So also UO_3 is a well-known oxide of uranium, yet until lately UCl_4 was the highest known chloride. The author has recently succeeded in preparing the penta-chloride UCl_5, which occurs as a light brown powder, and also as darker acicular crystals. Again, we have SO_2 and SO_3, but it is only very lately that SCl_4 has been obtained, and the compound is so unstable as to undergo dissociation at very low temperatures.—Dr. Debus suggested that the equivalency of many of the elements depends upon the element or elements with which they are united, and that hence these and other anomalous results.—The President remarked that he did not see why we should not expect to meet with examples of change of atomicity; that if we always found elements exhibiting an even, or always an odd number of atomicities, this was very remarkable, and called for explanation, but that we should not be surprised to meet with exceptions to the rule; indeed, that we could form no distinct physical idea of what we mean by "bonds of atomicity." He remarked that we cannot well use oxygen as a measure of atomicity, from the tendency which it so often exhibits of running into chains.

SECTION D—BIOLOGY

DEPARTMENT OF ZOOLOGY AND BOTANY

Dr. Moore called attention to a monstrous state of *Megacarpæa*, and also to a monstrous state of *Sarracenia*; after which he exhibited specimens of grafted roots of mangold wurzel, illustrating the transmission of special characters from the graft to the stock.

Mr. E. R. Lankester read a paper *On the genealogical import of the external shell of Mollusca*, in the course of which he referred to what has been called the recapitulation hypothesis, according to which all living things in their development present a rapid series of pictures or dissolving views of their ancestors, arranged in historical order. Applying this to the human race, he said that the earliest commencement of a human being was a small speck of protoplasm of mucus-like consistency, such as existed in ponds. A later stage exhibited him as a small sac, composed of two layers of living corpuscles, which he inherited from polyp-like ancestors, and was to-day seen in polyps. Still later he was an elongated creature, with slits in the side of the neck, which, like the gill-slits of a shark, he inherited from a shark-like ancestor. Six months after birth the child continued to inherit qualities from its ancestors, viz., from those which crawled on four legs; and at a later period certain irrepressible tendencies made it clear that qualities were inherited from climbing and shrieking animals. Mr. Lankester then went into an elaborate description of certain molluscs with a view of showing that the pen of the cephalopod is homologous with the shell of the lower Mollusca.

Prof. Huxley thought that the position had been well established. Mr. Lankester's attempt to reduce to one form the immense variety of shells in molluscous animals was exceedingly important.

Dr. Carpenter also said that he was almost prepared to receive the conclusion at which Mr. Lankester had arrived.

Dr. M. Foster added his testimony to the value of Mr. Lankester's observations, and said that part of the work accomplished was due to the establishment of the zoological station at Naples.

Mr. W. Archer read a paper *On a new form of Proteus*, Prof. Cunningham contributed a short paper *On two Species of Crustacea*, one belonging to the remarkable fresh-water genus, the *Atya spinipes*, and the other belonging to an apparently undescribed species of the genus *Pontonia*, which are remarkable for being found as tenants of the shells of living bivalve molluscs. The two specimens were found in the Singula Archipelago.

A paper, contributed by Mr. T. Lister, *On the Spring Migrating Birds of North England*, was read by Prof. Cunningham.

Mr. E. R. Lankester brought the subject of *English Nomenclature in Systematic Biology* before the department, and said it would be a considerable gain to science if there could be introduced a series of terms distinctly English in their etymology, which would be accepted as authoritative and used throughout the country. The only question was whether it was possible, by any action on the part of scientific men, to introduce such a series of terms. He suggested the appointment of a committee of men whose names would be received as authoritative throughout the country, to draw up a list of terms which should be used for the groups of the animal and vegetable kingdom.

A discussion followed, in which Prof. Thiselton Dyer, Mr. Bentham, Mr. A. W. Bennett, Prof. Cunningham, Miss Becker, Prof. Dickson, and Dr. Sclater took part, the generally expressed opinion being unfavourable to the change proposed.

A paper was read by Mr. H. Airy *On a peculiar form of Leaf-arrangement.*

SCIENTIFIC SERIALS

Justus Liebig's Annalen der Chemie, Band 172, Heft 3.—This part contains the following papers:—Communications from the chemical laboratory of Greifswald.—86. On metatoluidine, by F. Lorenz. The author describes the preparation of this substance. Paratoluidine is first treated with acetic anhydride, and para-acettoluide thus obtained, which, by treatment with nitric acid, yields metanitropara-acettoluide. By heating with alcoholic potash this latter substance is converted into metanitroparatoluidine; this last body is acted on by nitrous acid, and the diazo-compound treated with alcohol leaves metanitrotoluol, which, by reduction with tin and hydrochloric acid, gives metatoluidine. Several of the salts of this base are described, likewise the conjugate sulpho-acids, dibrominated substitution derivatives, &c.—87. Note on the quantitative determination of paratoluidine in presence of orthotoluidine, by the same author.—88. On metabromorthosulphotoluic acid, by Dr. E. Weckwarth. The preparation of this acid, which possesses the formula $C_6H_2\left\{\begin{array}{l}CH_3\\ \left.\begin{array}{l}SO_3\\ Br\\ N\end{array}\right\rangle N\end{array}\right.$ is described. The potassium, sodium, barium, strontium, copper, and lead salts have been analysed, and the chlorine, amido, and nitro substitution derivatives examined.—89. On orthoamidoparasulphotoluic acid, by Dr. M. Hayduck. The barium and lead salts are first described; the brominated acid and its potassium, barium, and lead salts are next treated of. The amido acid distilled with potassic hydrate gives off ammonia, and aniline and a potassium salt of anthranilic acid, $C_6H_3\left\{\begin{array}{l}H\\ NH_2\\ COOK\end{array}\right.$ is obtained. With hydrochloric acid and potassic chlorate the amido acid yields trichlororthotoluquinone, $C_6\left\{\begin{array}{l}CH_3\\ O_2\\ Cl_3\end{array}\right.$, from which the corresponding hydroquinone has been obtained. By the action of bromine on the amido acid a dibrominated acid is obtained, of which the barium salt has been analysed. Diazo-orthoamidoparasulphotoluic acid, $C_6H_3\left\{\begin{array}{l}CH_3\\ \left.\begin{array}{l}N\\ SO_3\end{array}\right\rangle N\end{array}\right.$ obtained by the action of nitrous acid on the amido acid, is next treated of. This body acted on by water gives orthocresolparasulphonic acid. The nitro-diazo acid is finally described.—90. On a new nitro-toluidine, by Dr. O. Cunerth.—On paramido-orthosulphotoluic acid, by Dr. F. Jenssen. The nitro-acid, $C_7H_6(NO_2)SO_3H \cdot 2\frac{1}{2}H_2O$, and several of its salts are described, also the chloride and amide. The amido acid is then treated of, likewise its salts and substitution derivatives.—On some decompositions of pyroracemic acid, by Dr. C. Böttinger. This lengthy memoir is divided into three sections: the first treats of the decomposition of the acid in acid solutions, the second of its decomposition in alkaline solutions, and the third of its decomposition *per se*. Among other things the author describes in great detail the preparation and properties of uvic acid and its salts.—On acenapthene and naphthalic acid, by Arno Behr and W. A. Van Dorp. The authors have examined several of the salts of the acid, its methylic ether and anhydride. The constitution of the two bodies is also discussed.—Researches on the volume constitution of solid bodies, by Dr. H. Schröder.—K. Helbing contributes a paper on an examination of some benzene liquors, and one entitled "Research on a new earth resin." This resin is found in large masses in a stone quarry at Enzenau, between Tolz and Heilbrunn. Nineteen per cent. of the resin is soluble in ether, and nine per cent. in ether and hot alcohol. The insoluble portion contains iron pyrites and a hydrocarbon of the formula $C_{40}H_{62}$. The ethereal extract contains a substance of the formula $C_{40}H_{62}O_2$, melting at 192°. The hot alcoholic extract gave a substance of the composition $C_{40}H_{60}O_2$.—On cymene, by F. Fittica. The author establishes the identity of the cymenes from camphor, ptycholusol, and thymol, and furnishes evidence that the propyl contained in the cymenes is normal propyl. The isomeric oxy- and thio-cymenes are also treated of.—The constitution of benzene, by A. Ladenburg.—On derivatives of phloretin, by Hugo Schiff. The author treats of the preparation of phloretin, of phloretic acid, and phloroglucin, likewise of phloroglucide and of triphloretide. The present part contains the index for vols. 169, 170, and 171.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Aug. 15.—Dr. H. Wild contributes to this number some suggestions for the consideration of the Permanent Committee of the International Congress on the question of the establishment of an International Meteorological Institution. Before the Congress at Vienna he was altogether in favour of the scheme, but now feels persuaded that one institution could hardly exercise the large functions proposed with advantage. The difficulty of directing from one spot a number of stations scattered over the globe would be great, the conditions of these stations would not be familiar, the construction of isobaric charts, &c., could only be undertaken with exact data and co-operation of the central national offices, and the modification of instruments, &c., would not be a proper task to be attempted at any one place, with its narrow range of climatic conditions. The failure of one of the central offices would cripple the results produced by the Institution, and, besides, the energetic working of these offices would be endangered if they were to delegate some of their present problems to the Institution. The national offices which now occupy themselves with general meteorology might bestow too much attention to local matters. These objections would be avoided if each central office were to attend specially to some branch of the meteorology of the globe mutually agreed upon; for instance, one to the preparation of synoptic charts, another to rainfall, and so forth. The results of the various lines of research could then be interchanged, and the failure of one office would not damage the work of the others. The establishment and maintenance at common expense of international stations proper in uncultivated countries, and the publication of their observations, Dr. Wild holds would be best undertaken by the countries to which these stand in the nearest relation. There would remain, then, for the Institution the work of interchanging the results and keeping up the relations of central offices, the arrangement of occasional Congresses, questions concerning instruments, and the like.—Among the *Kleinere Mittheilungen* we observe an abstract of the important report of Mr. Blanford to the Government of Bengal for the year 1873.

Poggendorff's Annalen der Physik und Chemie, No. 5, 1874.—In 1868 Prof. von Rath published some observations on a form of silica to which he gave the name Tridymite. It always crystallises in twin hexagonal prisms, and has a low specific gravity. His further observations show lines of division between the elements forming the twins, and in these lines the third crystal in tridymite is developed. There is a similar persistence of the division plane between crystals of humite, and analogous triple crystals in anorthite, and an interlacing of crystals in leucite; and he concludes that while two crystals cannot be united to each other in many crystal groups, yet they can be united to a third crystal. Fine specimens, three millimetres long, reaching him from the trachytes of Pachuca in Mexico, he has made full measurements. The crystals, however, are generally of small size relatively to the accompanying minerals. They commonly occur in drusy cavities of the trachytes associated with specular iron, hornblende, and augite. Details are given of the mode of growth of the twins, their various forms and intimate combinations.—Another paper by the same author describes a remarkable crystal of calc-spar from Lake Superior. It is shown by the formulæ of the faces to be a form which is distinct from any hitherto observed. It is transparent, and occurs with native copper in amygdaloid melaphyre.—Another paper by Von Rath is on a singular combination of rutile and specular iron. The fine spiculæ of rutile are developed from between the plates of a red kind of specular iron, and may be a subsequent formation. It occurs in association with crystals of quartz and adularia in clefts or druses in a fine grained talcose gneiss.—Von Rath's next paper is On remarkable artificial crystals of pure copper. At the meeting last year of the German Geological Society at Weisbaden, Prof. v. Seebach exhibited crystalline copper which Prof. Senft of Eisenach had obtained by galvanic electricity between small rings of zinc and copper. From an aggregation of very small crystals a large mass was formed of the size of four millimetres. The crystals are always twins, with the free end most produced, and have a form which has not heretofore occurred in native copper, though it has been found in galena and binnite. The octahedral faces of the crystals are flat and shining, while those of the icositetrahedron are curved and less perfect.—Another paper discusses the hypersthene of Mont Dore, described by Des-Cloizeaux, a mineral which there occurs in druses in trachyte in crystals three millimetres long, associated with crystals of sanidine and tridymite.—Von Rath's last memoir describes a new zeolite, named foresite, from the tourmaline granite of Elba.—Prof. Th. Petruschevsky, of St. Petersburg, who has devoted himself since 1862 to the phenomena of magnetism, now publishes the results of his investigation on the direct and indirect determination of the pole in magnets. Starting with the basis of Biot's curve of magnetic intensity, he points out that it is as easy to determine the pole theoretically as empirically, details his two methods, and the apparatus wherewith they are tested. He then considers the determination of the pole in electro-magnets, and finally enumerates results.—Dr. Gustav Junghann explains a simple law for the development and grouping of crystal zones. He introduces some maps of anorthite into the memoir, in which the formulæ of the faces are all set down in tabular form in square spaces.—Herr G. Hagen contributes a memoir On the resistance offered by the air to plane discs moved through it.—Herr J. J. Muller examines one of the Hamiltonian theories of movement which underlies the principles of mechanics.—Herr von Laspeyres has an interesting experimental paper On the existing and a new thermostat, and Herr Rammelsberg describes the crystalline form and modifications of selenium.—The most interesting reprinted paper is Terquem's account of the vibroscope for accurately determining number of vibrations.

SOCIETIES AND ACADEMIES

LEEDS

Naturalists' Field Club and Scientific Association, Sept. 15.—Mr. Edward Thompson, vice-president, in the chair.—Mr. James Abbott mentioned that he had gathered *Butomus umbellatus* in flower at Kirkstall, on Sept. 12. The plant had not been noted in the Leeds district for upwards of twenty years past, when it grew in the stream at the foot of Woodhouse Ridge.—Mr. Henry Pocklington, in conjunction with Mr. James Abbott, demonstrated the action of the induced current upon the protoplasmic gyrations in the cells of *Vallisneria spiralis*, by means of a simple electric slide and a small inductorium. The effect produced was very marked. The circulation of the protoplasm stopped almost instantly. It was, in fact, as was described by one of the members, as though a strong "break" were put on. The protoplasm was corrugated by the rapid contractions induced, and the results taken altogether were of the most interesting character. Mr. Pocklington will probably communicate a more complete description of his apparatus and its results at an early date.

PARIS

Academy of Sciences, Sept. 21.—M. Bertrand in the chair.—The following papers were read:—Note on barium sulphocarbonate, by M. P. Thenard. Since M. Dumas' proposal to use sulphocarbonates for the destruction of *Phylloxera* these salts have acquired a new interest. The barium salt is easily prepared by agitating a strong solution of barium sulphide with carbon disulphide. The author describes a process for manufacturing this salt on a large scale, and proposes to turn his attention to the manufacture of the potassium salt.—On a new mercury pump, by M. de Las Marismas. This apparatus is stated to cost 35 francs, and to exhaust a receiver of six litres' capacity to one millimetre pressure in four minutes; all pressures from that of the atmosphere up to an absolute vacuum can be obtained, the gas contained in the receiver can be collected if necessary, and a vacuum can be preserved indefinitely.—On the action of alimentary or medicamental liquids on tin vessels containing lead, by M. Fordos. The author has tried the action of wine, vinegar, lemonade, &c., upon hospital vessels containing 10 per cent. of lead; this latter metal was invariably found in the fluids used, and the author concludes that the use of this alloy may be attended with great danger.—Researches on the colouring matters of garancine, by M. A. Rosenstiehl. The colouring materials of garancine—alizarine, pseudopurpurine, purpurine, and its hydrate—have all been investigated in great detail by the author. Purpurine and its hydrate are formed at the expense of pseudopurpurine; the products of the reduction of purpurine have been studied, and two isomers of this body obtained, one of which has been prepared by synthesis starting from benzoic acid. Pure alizarine is prepared by heating the commercial substance with water to 200° C. for some hours, a small quantity of caustic alkali being added. Impurities are totally destroyed by this treatment, and the product of the operation is further purified by frequent crystallisations. Pseudopurpurine is a very unstable body; heating with water or alcohol transforms it into a mixture of purpurine and its hydrate. From the present researches it seems that garancine red and the rose colouring matter yielded by garancine flowers cannot be obtained from alizarine alone; the presence of purpurine or its hydrate is indispensable. The product of the action of reducing agents on purpurine and its hydrate is purpuroxanthine, an isomeride of alizarine.—New experiments on the nature of the sulphuretted principle of the waters of Luchon, by M. F. Garrigou. This is a reply to a paper by M. Filhol in the *Compt. Rend.* for Sept. 7.—Observations relating to a recent communication by M. Lichtenstein on some points in the natural history of *Phylloxera vastatrix*, a letter from M. Balbiani. The author again enforces his views as to the non-identity of the *Phylloxera* of the vine and of *Quercus coccifera*.—M. P. Thenard made known to the Academy the measures adopted by M. le Préfet de Saône-et-Loire on the approach of *Phylloxera*.—M. le Ministre de l'Agriculture et du Commerce and M. le Ministre des Finances consulted the Academy on the employment of tobacco juice for the destruction of *Phylloxera*.—Communications relating to *Phylloxera* were also received from MM. J. Bond, H. de Martiny, R. Delpit, &c.—Properties of the "implexes" of surfaces defined by two characteristics, a geometrical note by M. Fouret.—On luminous diffusion, by M. A. Lallemand.—On Warwickite, by M. J. Lawrence Smith. The author assigns to this mineral the formula $\dot{Mg}_4\overset{\prime\prime\prime}{B}_3 + (\dot{Mg}\dot{Fe})\ddot{Ti}_2$.—On the *rôle* played by gases in the coagulation of blood, by MM. E. Mathieu and V. Urbain.—On the movement in the bilabiate stigmata of the Scrophulariaceæ, Bignoniaceæ, and Sesameæ, by M. E. Heckel.—Observation of a bolide at Versailles on the evening of the 14th of September, by M. Martin de Brettes.

CONTENTS

PAGE
HINTS ON MEDICAL STUDIES 435
NOMENCLATURE OF DISEASES 436
LETTERS TO THE EDITOR:—
    The Education of Women.—Lieut.-Col. ALEX. STRANGE, F.R.S . 437
    Double Rainbow.—Prof. TAIT, F.R.S.E.; Prof. J. CLERK-MAXWELL, F.R.S. (*With Illustration*) 437
    Curious Rainbow.—T. W. BACKHOUSE; ARTHUR SCHUSTER . . 437
    Mist Bows.—HOWARD FOX 438
    Carnivorous Plants—how to be obtained.—G. H. HOPKINS . . . 438
    Automatism of Animals.—I. D. WETTERHAN 438
    Photographic Irradiation.—JOHN AITKEN 439
    Can Land-crabs Live under Water?—J. C. GALTON 439
    Salivary Glands of Cockroach.—CHAS. WORKMAN 439
THE AUSTRIAN POLAR EXPEDITION 439
THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE . 441
REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL," VII. (*With Illustrations*) 444
NOTES 446
THE BRITISH ASSOCIATION. REPORTS AND PROCEEDINGS 449
SCIENTIFIC SERIALS 453
SOCIETIES AND ACADEMIES 454

ERRATUM.—Vol. x. p. 416, col. 1, line 22 from bottom, for "Norway" read "Moray."

THURSDAY, OCTOBER 8, 1874

PROFESSOR HUXLEY AT MANCHESTER

PROF. HUXLEY, whose breadth of view at once claims attention for all he utters, has utilised the opportunity afforded him by the opening of the new Medical School at Owens College to call attention to several points the discussion of which at the present time is of the most vital importance.

The rapid growth and increasing importance of Owens College are known to all our readers, and the recent addition of the new Medical School has added still another Faculty to that teaching centre, so that, as Prof. Huxley very properly points out, the College is a University in the old sense in everything but the name. A University in the new sense of course it is not, because it does not yet possess the power of granting degrees. But we imagine that the distinguished men who are directing teaching and research at Owens College can well afford to wait for this privilege, if privilege it be, especially if older foundations set an example of emphasizing this portion of their work to the neglect either of sound practical teaching or the advancement of knowledge which we regard as of still higher importance.

Prof. Huxley, by his approval of the location of the new Medical School side by side with Arts and Science Faculties, has not only brought again to the front the miserable condition of the majority of our Medical Schools, but has called into question the whole policy of Colleges of Science and Institutions for Technical Training. This part of his speech is so important and so connected, and there is so much to ponder over in it, that we give it entire :—

"Your Faculty of Arts speaks for itself; the distinction of many of its members, and the fact that they are authors of works well known and esteemed all over England, and wherever the English language is read, is sufficient to give that Faculty a high position. It certainly would not become me to speak of its operations as if I were a judge of them in any way whatever; but I may be allowed as a person whose pursuits lie elsewhere, and who has the misfortune to be accused sometimes of seeing no merit and desert in anything but his own pursuits, to say that I trust that the position of the Arts Faculty in this institution will never by a hairbreadth or shadow be diminished, but that a sound and thorough training in literature and general knowledge will be regarded henceforward, as very properly it is now, as the essential foundation in the intellectual life of every educated man; and let me say, to no person is such education and such training of greater importance than to us who are called men of science. Our occupations are very engrossing, and they can be pursued with success only by the intensest stress and attention, and we are obliged even to limit ourselves to particular fractions and particular portions of our own study if we are to make any advance therein; and unless we have the good fortune to be trained in early youth to take a broad and general view of the interests of human nature, unless our tastes are disciplined and refined, and unless we are led to see that we are citizens and men before anything else, I say it will go very hard indeed with men of science in future generations, and they will run the risk of becoming scientific pedants when they should be men, philosophers, and citizens. Still less, if possible, can I have anything to say respecting the Faculty of Law, but as regards that of Science, by which, of course, is understood physical science, I can only express my unmeasured satisfaction at the complete—I may almost say magnificent—arrangements provided for the teaching of this subject in this institution. The laboratory of my friend the Professor of Chemistry has, I take it, few parallels; and if the laboratory of my friend the Professor of Physics is not so complete, I am sure it is far better than nine-tenths of such laboratories, and I am certain that those benefactions at which I was looking just now will, before long, enable him to put his establishment on the same footing as to completeness and magnificence as that of his colleague of Chemistry. I understand—indeed I know very well, knowing how much my distinguished friend, Prof. Roscoe, has been in this institution—that he had, I believe, the advantage of being on the spot when the building went on, and although I am sure he is the last man to take any more than his own share, somehow he has got a good deal. But now I come to that which is my proper subject to-day, and that is our Medical School. I have not seen in the course of my experience—I say it deliberately—I have not met with any more efficiently organised institution than you have within the four walls of that Medical School. I have some acquaintance with such institutions, and their interests, and I undertake to say that you will not find better constructed appliances for the teaching of those branches of science which relate to medicine than you will find in that school. Everything has been very carefully considered, and everything has been done which the idea of convenience could suggest, or which efficiency requires to have carried out. Addressing myself now rather to the lay portion of my audience, it may astonish many and puzzle them somewhat to know why so elaborate an apparatus is needed for the teaching of medicine, and why men require to spend so long a period of arduous study in that most important of pursuits. I believe this surprise arises from the prevalence in the general mind of the notion which was once exceedingly common in the philosophical mind, that the human body in general is dependent upon forces and powers which are altogether different from those we find working in other kinds of matter. It is not 200 years since the notion existed that the vital processes of the body were subject to some demon, who kept the body straight, I suppose when in good temper, and let it go wrong when out of sorts; and when it was gravely supposed that there was a broad gulf between the phenomena of inorganic nature and those of life. Now let me say this, that the whole of our modern scientific study of medicine depends upon precisely the contrary assumption —upon the assumption that the living body is a mechanism infinitely more refined, and infinitely more difficult to understand, than our coarse human machinery, but still a mechanism governed by rules and laws which can be discovered and which can be applied and reasoned from, in order to understand its processes. Modern medicine, in fact, is a kind of engineering. It is the attempt to understand the machinery of the body for the purpose of being able to put it right when it goes wrong. I have seen in your great factories in Manchester some of those astonishingly complicated pieces of machinery which seem almost endowed with life, by which the products which make Manchester so famous are produced. Let me put before you the case of the possessor of one of those machines, who, finding that it has gone wrong and that it will not work properly, finds himself, as Sir Robert Peel would have said, with three courses open to him—either that he might sit down and hope that it would get better, and perhaps even offer up his prayers that it might get better; or who should send to the nearest blacksmith and tell him to bring his hammer and bottle of oil, and tap here, or oil there, in the chance of setting the machine right; or should, thirdly, send for some skilled and experienced mechanic who from long study and familiarity with it would be able to judge by the mode of action where it was wrong, and be able to put his finger on the part which

> was broken or injured, and thus be able to set it right. Now, the human body is a machinery which, in complexity, stands to the spinning jenny in the same relation as the spinning jenny stands to a child's windmill. But it stands by the same laws, and those who have to deal with it must be guided by the same reasoning. Sickness is the going wrong of the machinery. Death is the destruction of part of the machinery, and the only way in which that machinery can be set right, if it goes wrong, is not by sitting down and hoping for it, and it is not by sending for the first blacksmith who will administer his purge here and his bleeding there; and who is what we call a 'quack.' I mean a person who is really ignorant of that with which he is dealing, and who yet, nevertheless, presumes to meddle with it. That is the essence of quackery. Or, thirdly, we must send our skilled engineer, who, by the help of what he calls symptoms, finds out what wheel is out of place, what cog is broken, and by his previous knowledge of therapeutics knows in what way it is possible to get this erring wheel or broken pinion into its place again. And it is in order that we may have such skilled engineers to the body that all this great apparatus which you see erected here, and all this long period of study is carried out. I do not know anything which strikes me more forcibly than the progress which this kind of knowledge has made within the last thirty or forty years. . . . I happened to take up to-day the syllabus of your sessional work here, and I turn, not unnaturally, to the class of Practical Physiology and Histology, and on looking over the various doings of this course of instruction, it struck me that thirty years ago, when I began my medical studies, there certainly was nobody in London—nay, nobody in the world—who could have given you this course of instruction. We had not the instruments which are necessary to carry it out. The whole course of medical study since that time has been completely changed—in the first place, by discoveries made by the use of the microscope, and, in the second place, by that application of delicate instruments to the illustration of the mechanism of the body, which is the very essence and a great part of modern physiology. At that time even organic chemistry was hardly in existence. It is this recognition of the fact that the study of life is essentially a question of applied physics and chemistry which has changed the whole course of our medical studies. It is that which makes elaborate appliances necessary.

The main question raised by Prof. Huxley in these remarks is, in our opinion, really this: Are we in the future to mass our Faculties as they are massed in Germany, or are we to separate them as they are separated in France?

The altogether glorious mental activity of the Germans in the present century is undoubtedly due to the commingling of the teaching of the various Faculties, and to the University teaching universally available. In Germany it may be said that there are no provincial institutions, for the smallest universities are modelled on the largest, and are as perfect, so far as they go. The metropolis is thus carried into the provinces.

Contrast this with the condition of things in France, with its single University and special scientific schools, and where outside Paris there is no institution, so far as we are aware, where all the Faculties exist side by side, and are conducted with equal vigour. Medical Faculty here, Law Faculty there, Arts Faculty somewhere else, and Science Faculty again in another region; such is the condition which is now being severely criticised by many of the best minds in France. But it must be remembered that while the whole of France besides Paris is so lamentably provincial, in Paris itself there are facilities for advancing and distributing knowledge which put London *plus* Oxford and Cambridge to shame.

In provincial England we fear it may be said with too much truth that we are at the present moment behind France. It is clear that in Owens College we have an institution which will correct the existing condition of things on the German plan; in such institutions as the Yorkshire College of Science we have attempts to correct it on the French plan, a plan condemned utterly by the most far-seeing men in France itself; while we have not in England the corrective supplied by Paris, considered as a vast centre of teaching and research.

We are glad that Prof. Huxley has called attention to the importance of the step taken by Manchester, and has so clearly stated his idea of the right thing to be done for the advancement of the higher education.

Nor did he neglect to point out the intimate connection that must exist between this and the secondary education before any real progress can be made:—"You who commence your medical studies should come prepared with the outlines of physics and chemistry as your foundations. One of the great reasons of the backwardness of medical study is that those who come to study are, by reason of the lamentable defects of their common school education, utterly unprovided with a knowledge of what those physical studies mean. I wish to stamp upon your minds, as firmly and as strongly as it is burnt into my own, that all these appliances and all these mechanical aids for the study of medicine are simply thrown away unless they have the foundation of human hard work and clearheadedness to go upon."

Still another point of the most vital importance to the future progress of Science in this country was touched upon; we refer to Prof. Huxley's statement of opinion as to the importance of the Research Scholarships established at Owens College:—

> "I notice in these donations and in these sums of money subscribed for the purpose of building and endowing and providing with scholarships this great institution, what appears to me to be a peculiar feature; at least I know nothing exactly like it anywhere else: and as it appears to me to be a feature of great importance and one which it is desirable to imitate as fast as possible by other educational bodies, you will pardon me if I dilate upon it for a short time. You have two scholarships which differ from the ordinary scholarships in this, that they are rewards not merely for learning, and not merely for careful attention and diligent study of that which the student may learn in the lecture-room or from books, but they are rewards which are given to those who exhibit in some degree that most valuable and most important of all intellectual gifts, the power of advancing truth by the pursuit of original research. I refer to the Dalton Scholarship and the Platt Scholarship. I can conceive no object more important at the present time than that of encouraging original research in science, and the way of doing it, without at the same time doing more harm than good, is one which has come very seriously under my consideration as one of the Royal Commissioners for the Advancement of Science, and I earnestly wish that we could look elsewhere to the solution of that problem by means analogous to those adopted here—I mean to say by private benefactors coming forward with their endowments, which endowments should benefit those only who are engaged in original research. The introduction of scholarships of this kind into the

early life of young men, when it is so important that their attention should be directed to original research, is a new feature in this institution, and permit me to say, however important the institution may be in other respects, I am not sure that it is not one of the most important of its features."

It will be seen that while Prof. Huxley acknowledged the necessity for the endowment of unremunerative research, speaking as a Royal Commissioner, he acknowledged also that there are difficulties which surround the solution of the question. We are glad of this, because if the things were easy it would certainly not require that the machinery of a Royal Commission such as the one now sitting should be set in motion; nor, let us add, would it be worth Prof. Huxley's attention. In the fact that the question is a difficult one we see the best justification for the best minds in the country being brought to bear upon it, and we may safely anticipate a satisfactory solution.

THE REPORT OF THE METEOROLOGICAL COMMITTEE

Report of the Meteorological Committee of the Royal Society for the Year ending December 31, 1873. (London, 1874.)

THE proceedings of the Meteorological Committee of the Royal Society for 1873 are detailed in the above Report. The discussion of the meteorology of the district of the Atlantic Doldrums, known as Square 3, has now been completed, and this piece of work, which the Committee consider may fairly be termed a monograph for the district, will shortly be published. The examination of the eight squares adjacent to Square 3 has already been entered upon. The discussion of the results of Sir J. Ross's Antarctic expedition, from the observations made on board H.M.S. *Erebus* and *Terror* in 1840-43 and H.M.S. *Pagoda* in 1845, has also been completed and published, and is a paper of considerable value. Another good piece of work done by the Office is the examination, at the request of the Astronomer Royal, of the observations bearing on the meteorology of Kerguelen Island for the month of December, the results of which have been forwarded to those who are now stationed there to observe the transit of Venus.

We are glad to see that an increasing regularity in the receipt of the Weather Telegraphic Reports is notified, and we very cordially join in the regret expressed by the Committee that the Post Office authorities have declined to extend the telegraph wires so that a station might be established at Mullaghmore, near Sligo. In consequence of this action or want of action on the part of the Post Office, the Meteorological Office continues to be without daily information along the whole of the important and extended line of coast from Valencia to Lough Foyle. We hope that this blank will soon be filled up, and further, that some arrangement will be entered into by which a constant service will be maintained on the west coasts of these islands, and also at the Head Office in London; for until this be carried out, our system of weather telegraphy must, of necessity, not unfrequently fail to give warning of approaching storms. A comparison has been instituted, as in the three previous years, between the warnings issued and the weather experienced on our coasts, with the general result that the total success of warnings for 1873 was 79·2 per cent. as compared with 80·5 per cent. for 1872. In 1870 and 1871 the percentages of success were 68·4 and 63·7 respectively. The mean of these four years is nearly the same as that of the last two years when the office was under Admiral Fitzroy's management, but it will be observed that 1872 and 1873 show the largest number of successful warnings.

The restoration of Admiral Fitzroy's system of warnings, so far as to announce in the warning-message the probable direction of the apprehended storm, is a step which, we see at p. 51 of the "Report on Weather Telegraphy and Storm Warnings, presented to the Congress at Vienna," was strongly urged by the council of the Scottish Meteorological Society upwards of a year ago. The practical restoration of Fitzroy's system has been effected by the Committee, and the change took effect in March last, with, however, the very decided improvement of employing the drum simply to emphasize the warning given by the cone, instead of denoting, as it did originally, "dangerous winds from nearly opposite quarters successively." The Committee have attempted to assign the degree of probability to a storm announced by signal, thus: "Hitherto it has been found that at least *three* out of *five* signals of approaching storms (force upwards of 8 Beaufort scale, a fresh gale), and *four* out of *five* signals of approaching strong winds (force upwards of 6 Beaufort scale, a strong breeze), have been fully justified." We observe with some interest that the Committee have directed that tentative forecasts should be prepared daily in the office, and compared with the facts experienced subsequently, and that they hope ere very long to be able to afford the public the benefit of the information. For the successful development of the important question of weather probabilities, it will be necessary that the Committee investigate weather changes over a much wider area than is covered by the daily weather charts. In this direction, the reports begun to be received during 1873 from Sweden and Denmark will prove to be of considerable utility; but for the success of the experiment it will be necessary that daily reports be also received from points in the north-west of Russia, and in Germany, Austria, and Switzerland.

The anemometrical returns from Bermuda for four years have been published. These observations, and similar observations made at Sandwich, Orkney, previously published by the Committee, have been discussed by a method which cannot be recommended. The results are worth little, and altogether inadequate to the expense incurred in their discussion. The discussion of no meteorological data at all approaches in difficulty that of wind observations, and it is necessary at the outset to apprehend the difficulties to be overcome.

In several cases the language used in the Report is inexact and tends to mislead. Thus an excess of high winds on the coast of Scotland during 1873, and a deficiency on the coasts further south, are stated to be explained by the circumstance that in 1873 "the paths of the storm centres lay to the northward of the British Isles, so that our stations felt the barometrical and other meteorological disturbances, but were not exposed to the full force of the wind." Now, as is pretty well known among meteorologists, in previous years the immense majority of British storms have had their centres to the northward of the British Isles. The proximate cause of the peculiar distribution of storms of wind during 1873 lay not in the position of the paths of the storm-centres, but in the manner of the distribution over Great Britain of the steeper barometric gradients of the atmospheric depressions of the storms of 1873 as they swept eastwards over north-western Europe.

It would have been satisfactory if the comparison which has been instituted by the Office between the observations from Valencia, in Ireland, and Angra do Heroismo, in the Azores, had been detailed in the Report, seeing that it is inferred from the result, "beyond the possibility of a doubt, that reports from a station situated at the Azores would be practically useless to the Office in giving early intimation of approaching storms." The grounds of this strongly-expressed opinion on a point of some importance in weather telegraphy, and contrary to the views entertained by not a few meteorologists, ought to have been stated.

In the Committee's Quarterly Weather Report for 1870 the position of the thermometers at each of their seven observatories was described and figured. We hope that in the next Report a detailed account will be given of the position and exposure of the thermometers at the stations from which the daily telegraphic weather reports are sent, in order that meteorologists may judge how far the observations made at these stations might be available in investigating the climate of the British Isles, and in some other meteorological inquiries. This is by many deemed necessary, especially when it is considered that the Office has not hitherto published any mean temperatures from the daily observations made at their telegraphic stations, and some of these stations, particularly in Ireland, are in parts of the British Isles, of whose climate little is yet known.

GEOLOGY AND AGRICULTURE

Applications de Géologie et l'Agriculture, par M. Amédée Burat, Engineer, Professor at the Central School of Arts and Manufactures. (Paris: Rothschild, 1874.)

GEOLOGY is one of the most interesting of modern sciences. Soon after it assumed shape high hopes were entertained as to its value to the farmer: up to the present these hopes have not been realised. And yet the study of geology is most intimately connected with agricultural pursuits. Surface geology deals with the soil which daily occupies the thoughts and labours of the farmer. There is one phase of surface geology which has been almost wholly neglected of late; we refer to the connection between soils and the rock-formations from which soils have been derived. It is here possibly that there is the widest field for original research. It was hoped that this branch of agricultural science would have received much attention from the present secretary to the Royal Agricultural Society of England, who had previously been a diligent student of geology and secretary to the Geological Society. So far, his hands would appear to have been full of other work, and he has done little where much was expected.

That there is a most intimate connection between soils and rock-formations is well known. In some places the soil is the direct product of the disintegration of the underlying rock. It more frequently happens, however, that the soil has not been derived from the rock on which it rests, but consists of drifted material. The study of this drifted material is most interesting to the geologist, and ought to be most instructive to the farmer. It enables the geologist to understand the direction and force of former water-currents; and thus throws light on obscure phenomena. A careful examination of the drift enables us to trace the origin of the soil. Thus, for example, a study of the stones and pebbly particles of the soil, enables us not only to know the rocks from which it was derived, at all events partly, but also to understand the rate at which plant-food may become liberated on the soil by the disintegration of these very stones and pebbles. On this point a word of explanation may be here offered.

If we examine a fertile soil at any time we shall find that only a very small portion of its substance (seldom more than one per cent.) is in a condition fit for nourishing our crops, the great bulk of its substance being locked up in a condition at the moment unavailable. By the action of air, of moisture, of heat, and of manure, part of this unavailable matter becomes available for crops. It is on the rate at which the process of disintegration—or liberation of plant-food—takes place that the *natural* power of production of the soil chiefly depends. The study of agricultural geology from this point of view is manifestly of the highest scientific and practical importance: it opens up a wide field for original research. We had hoped, on receiving M. Burat's little volume, that he would have taken up the subject. We have been disappointed.

The work is, not, however, without merit. The language is simple, and the style as lucid as need be.

In the introduction the author leads the reader to expect a fuller exposition of the relation between geology and practical farming than he will find in the volume. The book contains four chapters. The first is a disquisition, couched in very general terms, on the physical characters and composition of soils. As an illustration of the very general character of the matter we quote the average composition of fertile soils (p. 8):—

Every 100 parts contain—

35	gravelly particles	of the size of peas
45	ditto	ditto millets
10	ditto	of fine sand
10	ditto	of fine material, separable by washing.

We are next furnished with a general "ultimate" chemical composition of an average soil. Information of this kind possesses no value except to the junior student.

The second chapter is devoted to manures, which are treated in a popular manner. The third chapter is on the action of water, and the subject is treated in an interesting manner; the services of the Abbé Paramere are duly acknowledged. The fourth, and last, is the most interesting chapter in the work. Here the author shows very clearly that there is a connection between geology and agriculture, drawing illustrations from the primary, secondary, and tertiary groups of rocks. Soils formed from granitic rocks are, in Great Britain and Ireland and elsewhere, deficient in lime. In our own experience we have seen most valuable results produced by the application of lime to these soils; and we learn from M. Burat that by the same means several districts in the West of France, which formerly were unable to maintain their people without extraneous supplies of food, have (*i.e.* by the use of lime) become the largest exporters of grain. All the author's illustrations are taken from France, but they have their counterparts in these islands.

On the whole, we are justified in saying that the little work will well repay perusal.

OUR BOOK SHELF

Flora of Dorsetshire. By J. C. Mansel-Pleydell. (London: Whittaker and Co. Blandford: W. Shipp.)

Flora Cravoniensis: or, a Flora of the Vicinity of Settle in Craven, Yorkshire. By John Windsor. (Manchester: Cave and Sever, 1873. Printed for private circulation.)

ALTHOUGH the boundary-lines of our counties are, as a rule, purely arbitrary, it is probably wise for the compilers of local floras to maintain them rather than to erect new ones of their own. The area of their observations is, at all events, thus rendered perfectly clear and certain. Dorset has long been famous for its palæontological wealth, both vegetable and animal; and we have here a record of its living flora, which, as might be expected from its length of sea-board and its variety of geological formations—lias, oolite, forest marble, Oxford clay, coral rag, Kimmeridge clay, Portland sand, Purbeck, chalk, and Eocene—is a rich one. The value of local floras depends greatly on the dependence that can be placed on the determination of the species by the editor and his *collaborateurs*; and on this point it seems to us that the present work can be safely trusted, great pains having been taken to establish the authenticity both of the localities and of the nomenclature. The county is divided into seven districts determined by the drainage, and therefore generally separated by high land; and a very good map of the county accompanies the volume. Among the greatest botanical rarities of the county (some of them almost unique) are—*Polycarpon tetraphyllum, Lotus hispidus, Simethis bicolor, Leucojum vernum* (doubtfully native), *Carex clandestina, Scirpus parvulus*, and *Cynodon dactylon.* The flora is confined to flowering plants and vascular cryptogams.

Mr. Windsor's "Flora of Craven" (the veteran author did not live to see its publication, or rather printing) is compiled on a different plan, the area being a somewhat arbitrary one: "about Settle and its neighbourhood to a moderate distance, generally within twelve miles, but in a few instances extending somewhat further." The district is a remarkably interesting one, whether from a geological or a botanical point of view; and the flora has been compiled with as great care as in the other case under notice, with the assistance of several good local botanists, and includes not only the flowering plants and vascular cryptogams, but also the Characeæ, Mosses, Hepaticæ, and Lichens. A district that includes among its native plants such rarities as *Polemonium cæruleum, Epipactis ovalis*, and *Cypripedium calceolus*, is of no ordinary interest.

Both these volumes are useful contributions to our library of local botany. We would especially commend to compilers of similar works the plan adopted by Mr. Mansel-Pleydell, of giving the geographical range of each species in the neighbouring counties of England and on the opposite coast of France.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Migration of Birds

THE subject to which Prof. Newton has called attention is one of great interest to all naturalists, and requires to be studied systematically; for I can hardly think that the solution is so "simple in the extreme" as Mr. Newton thinks it may be.

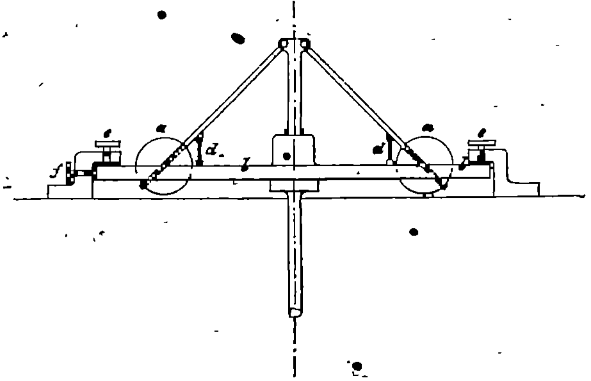
It appears to me probable that here, as in so many other cases, "survival of the fittest" will be found to have had a powerful influence. Let us suppose that in any species of migratory bird, breeding can as a rule be only safely accomplished in a given area; and further, that during a great part of the rest of the year sufficient food cannot be obtained in that area. It will follow that those birds which do not leave the breeding area at the proper season will suffer, and ultimately become extinct; which will also be the fate of those which do not leave the feeding area at the proper time. Now, if we suppose that the two areas were (for some remote ancestor of the existing species) coincident, but by geological and climatic changes gradually diverged from each other, we can easily understand how the habit of incipient and partial migration at the proper seasons would at last become hereditary, and so fixed as to be what we term an instinct. It will probably be found, that every gradation still exists in various parts of the world, from a complete coincidence to a complete separation of the breeding and the subsistence areas; and when the natural history of a sufficient number of species in all parts of the world is thoroughly worked out, we may find every link between species which never leave a restricted area in which they breed and live the whole year round, to those other cases in which the two areas are absolutely separated. The actual causes that determine the exact time, year by year, at which certain species migrate, will of course be difficult to ascertain. I would suggest, however, that they will be found to depend on those climatal changes which most affect the particular species. The change of colour, or the fall, of certain leaves; the change to the pupa state of certain insects; prevalent winds or rains; or even the decreased temperature of the earth and water, may all have their influence. Ample materials must exist, in the case of European birds, for an instructive work on this subject. The two areas should be carefully determined for a number of migratory birds; the times of their movements should be compared with a variety of natural phenomena likely to influence them; the past changes of surface, of climate, and of vegetation should be taken account of; and there seems no reason to doubt that such a mode of research would throw much light on, if it did not completely solve, the problem.

This is an appropriate opportunity for making a suggestion which has long been in my mind. It is, that it would be a valuable and interesting addition to NATURE, if we were supplied with a weekly (or monthly) "Calendar of Periodical Phenomena in Natural History," such as the average dates of appearance and departure of migratory birds, of the opening and fall of the leaf of our forest trees and common cultivated trees and shrubs; of the flowering of our common field and garden plants; and also the mean *highest* and *lowest* temperature of each *day*, the direction of the wind and amount of rainfall for each *week*, according to the Greenwich averages. None of this information is given in the usual almanacks or periodicals, and it is by no means easy to find it when wanted. Yet it is surely of much value to everyone who lives in the country, and would be the means of exciting an intelligent interest in such observations and inquiries as those to which Prof. Newton has called our attention in his interesting article.

ALFRED R. WALLACE

Regular Motion in Clockwork

IN order to ensure perfectly regular motion in the clockwork which drives the revolving dioptric apparatus made by Messrs. Chance, Bros. and Co., I have recently introduced a centrifugal governor, which might perhaps also be useful *for the clocks of equatorials.* Though it involves nothing new in principle, the form differs from anything I have seen, in that the governor balls have to lift a heavy weight, and that the leather rubbers or brushes are not carried by the revolving balls, but are fixed to the frame of the clock and rub against the disc which forms the extra weight lifted by the balls. The sketch shows the governor in use on the clock of the apparatus of Cape Bon, Tunis, an apparatus exactly similar to that now standing in the International Exhibition. It consists of a shaft making 170 revolutions per minute, to which the balls *a a* are hung, and on which the disc *b b* can slide, guided by a feather key. When the clock is below speed the disc rests upon a collar fixed on the shaft, the pull exerted by the balls through the links *d d* being insufficient to raise it; but as soon as the proper speed is attained, the disc rises and comes in contact with the screws *e e*, which are tipped with leather and fixed to the frame of the clock. Spaces are cut out of the disc to admit the balls, avoiding unnecessary height. The screw *f* serves as a brake to stop the clock at pleasure. I calculate that work to the extent of five foot-pounds per minute must be done on the governor to accelerate the clock one second per hour. This form possesses two advantages over that in which the rubbers are carried by the balls—1. It checks any acceleration of the clock more powerfully; 2. It is easier to adjust. In the older form it is necessary to ascertain by careful experiment that *each* ball shall bring its rubber into contact exactly when the speed is correct, whereas in this it is immaterial that the arms of the balls should be exactly equal; it is only needful that they should *together* raise the disc to contact when the speed is right. J. HOPKINSON



Glass Works, near Birmingham, Sept. 1

Rainbows

As a pendant to my note inserted in NATURE, vol. x. p. 437, I may mention that an exceedingly fine lunar rainbow was observed here at 8.40 P.M. on September 29.

Though the moon was near the last quarter, the bow was bright enough to appear reddish on one side and greenish on the other. It is the only one, of some five or six lunar rainbows I have seen, which appeared to show any trace of differences of colour.

I may also mention that about the end of August I saw, two hours after sunrise, a dazzlingly bright and gorgeously coloured parhelion in a small ice-cloud to the right of the sun, the rest of the sky being almost perfectly clear. There had been a sudden and considerable fall of temperature during the previous night.

St. Andrew's, Oct. 2 P. G. TAIT

IN NATURE, vol. x. p. 438, Mr. Schuster complains that in text-books no mention is made of supernumerary rainbows, and that the theory of them is to be sought in original memoirs, not generally accessible. Allow me to mention that in Sir John Herschel's Meteorology (a little work published by Black, price three and sixpence, and originally an article in the Encycl. Britann.), a complete explanation of the rainbow, and of the supernumerary bows as well, on the principle of interference, is to be found. F.M.S.

U.S. Weather Maps

IN Prof. Loomis's "Results of an Examination of the U.S. Weather Maps for 1872 and 1873" (published in the *American Journal of Science and Arts*, and recently noticed in NATURE, I am struck not only by the general agreement but by the almost verbal coincidence of one or two of his "Results" with some of the rules laid down in my work on the "Laws of the Winds prevailing in Western Europe," which was published in the beginning of 1872.

In "Laws of the Winds," Part I. p. 56 and following, I have shown that "we are unable to account for the eastward progress of depressions by attributing it to prevailing westerly upper-currents," but that "each system of depression appears to travel eastward with a kind of self-developed motion," and that the precipitation on the east side of the centre "is the principal agent in producing the change of geographical position." Prof. Loomis writes: "The progress of a storm eastward is not wholly due to a drifting resulting from the influence of an upper-current from the west, but the storm works its way eastward in consequence of the greater precipitation on the eastern side of the storm."

Prof. Loomis also appears to attribute the formation of some depressions, primarily developed in the United States, to the collision of moist air from the Pacific with the mountains in the north and west, in the same way as I have attributed the primary formation of some of our depressions to the collision of the vapour-laden atmosphere from the Atlantic with the high-lands in the west and north of the British Isles.

I am glad to observe that Prof. Loomis is no advocate of the "circular theory" of storms as still held by some meteorologists. He intimates the mean inclination of the wind towards the lower isobars as "more than 45°" in the United States. In the Journal of the Scottish Meteorological Society, No. xxxix. I have shown that at stations in the British Isles the mean inclination is 21°, but that it appears to be considerably higher in continental Europe.

In the work previously alluded to I have shown that depressions appear to travel most to the south when the atmosphere is warmer in the west than in the east, and most to the north under contrary circumstances, but that this influence is interfered with by another, viz., the tendency of depressions to travel so as to have the highest general pressures on their right. A less limited acquaintance even than I can claim with the U.S. Weather Maps would go far to show which of these two influences is the predominant, the general atmospheric conditions of the United States presenting a better field for their investigation than is to be obtained in Europe. Prof. Loomis finds that in North America storms tend most to the south in July and to the north in October. It would be interesting to inquire whether this observation holds good of depressions on the Pacific coast, as well as near the Atlantic. But a two years' average is insufficient to settle such questions.

On the whole it is satisfactory to find that some important results obtained from a study of European weather-charts are found, on good authority, to be in accordance with those derived from the U.S. maps. At the same time some of the theoretical remarks made by Prof. Loomis will not, I think, be generally endorsed by meteorologists. The statement that "it needs no argument to prove that when the wind is flowing from all quarters inwards upon a central area, there is a rapid accumulation of air, which can only escape by an upward motion," is incorrect; the depression of the barometer in the centre showing that there is no accumulation, but a rarefaction, produced in part, as Prof. Loomis has himself previously shown, by precipitation, and which is itself the cause of the influx.

Under the present conditions of anemometry all endeavours to calculate the upward movement in a storm from anemometrical data should also be accepted with much reserve. Still more hazardous (considering the inclination of depression-axes and the frequent difference of direction between currents at small and those at great elevations) is the attempt, in such an inquiry, to correct the observed velocities at sea-level by those on the summit of Mount Washington. With a depression in Eastern Canada a west wind not uncommonly blows on Mount Washington while more southerly airs are felt at the three nearest stations. If in such a case we calculate the amount of influx towards the depression-centre simply from the ratio between the velocity at sea-level and that on Mount Washington, it is obvious that the result will be the reverse of accurate.

Aug. 25 W. CLEMENT LEY

Aurora

ON Sept. 11 I was at Kyle Akin (Skye). The day had been wet and stormy, but towards evening the wind fell and the sky became clear. About 10 P.M. my attention was drawn to a beautiful auroral display. No crimson or rose tint was to be seen, but a long low-lying arc of the purest white light wa formed in the north, and continued to shine with more or less brilliancy for some time. The arc appeared to be a double one, by the presence of a dark band running longitudinally through it. Occasional streamers of equally pure white light ran upwards from either end of the bow. The moon was only a day old, but the old landscape was lighted up as if by the full moon; and the effect of Kyle Akin lighthouse, the numerous surrounding islands, and the still sea between, was a true thing of beauty, forming as it did a quiet contrast to the more brilliant but restless forms of auroræ generally seen. I particularly noticed a somewhat misty and foggy look about the brilliant arc, giving it almost a solid appearance. The space of sky between the horizon and the lower edge of the arc was of a deep indigo colour, probably the effect of contrast.

I regretted I had no spectroscope with me, as it would have been a fine opportunity to test the spectrum of an aurora of pure white light. I had a strong impression that the bow was near to the earth, and almost thought that the eastern end, and some fleecy clouds in which it was involved, were between myself and the peaks of some distant mountains. The eye is, however, deceptive in such cases, though instances are not wanting of auroræ close to the earth's surface. I shall be glad to know if other observations of this aurora were made.

Nairn, N.B., Oct. 3 J. RAND CAPRON

The Cry of the Frog

THE fact that the common frog (*Rana temporaria*) is capable of crying out lustily when he feels himself in danger, does not seem to have been frequently remarked. In my small walled garden there is a common frog who is persecuted by three cats. His residence is a heap of slates at the foot of an ivied wall, and here he is safe. But if he ventures far abroad his tormentors soon espy him, and though they seem nearly as much terrified as himself, they cannot resist the temptation to touch him with their paws. He immediately opens his mouth and utters a prolonged cry, which appears to be very surprising to the cats, who draw back for a few moments, and then pat him again, apparently out of mere curiosity, to be again scared by the same unusual sound. This sound is a shrill and rather sibilant wail, like the note of a small penny trumpet or the cry of a new-born infant. There can be no mistake about it, as I have repeatedly touched the frog with my own hand after driving the cats away, and the same cry has immediately followed, the lower jaw being dropped so that the mouth stands open about a quarter of an inch at the tip.

Leicester, Sept. 26 F. T. MOTT

The Woolwich Aeronautical Experiment

II.

IN order to discover the laws of the vertical motion, we must suppose that the balloon is resting in perfect equilibrium when on land; which means that the ascending power of the gas enclosed in the balloon is just equal to the weight of the canvas, netting, grapnel, ballast, passengers, &c. Under these circumstances the balloon will not ascend by itself, but it will with all the weight of the sand which may be thrown overboard, if a certain space is left for dilatation and the balloon is not quite full when resting on land. If the volume is V at the surface of earth, it will be $\frac{V H}{h}$ at an altitude where barometric pressure is h, being H at departure. When the balloon is quite full, gas escapes by the lower part under the shape of a whitish steam. If v is the additional volume which can be filled by dilatation, that phenomenon will take place at an altitude where the pressure is h given by the equation $\frac{V H}{V + v}$.

We suppose that the height h is never to be attained, and in fact it is desirable for the aeronauts to limit their altitude before starting, and not to fill their balloon with a gas which they are obliged to throw away by the valve or to see escaping by the *appendice* at some risk of their own safety; one of the greatest advantages of the vertical fan being to limit at will the ascent, as will be shown.

In our calculations we suppose that the canvas is not losing gas, that the sun is not affecting the balloon, and that no water is falling upon it, or no cloud concealing the sun. All these changes of temperature can be made the subject of special calculations, and the real motion of the aerostatic globe is the *mean* between all the different circumstances of the atmosphere.

If a balloon starts in an homogeneous air because a weight p of sand was thrown overboard, P being the weight of the air displaced by the balloon when resting on land, the motive power is $g' = \frac{g p}{P + p}$ and the laws of the motions of an Attwood machine are perfectly applicable to it.

The elevation takes place with an increased velocity up to the moment where the resistance of the air is = to g'. Consequently,

$$K v^2 = \frac{p g}{P + p}.$$

K being a certain coefficient which depends on the form of the balloon, its diameter, its netting, and the density of the air. K diminishes as the altitude increases, but the diameter of the balloon enlarges gradually to its utmost. As the law of diminution of pressure is not known, we are obliged to suppose $K =$ constant.

If we suppose a balloon of 60,000 cubic feet holding 50,000 cubic feet of gas when resting on the ground, the balloon can reach without losing gas (except by the loss through the canvas, which we suppose to be perfectly gas-tight) to a level where $H = \frac{5 h}{6}$ = about 6,000 feet in round numbers. Under these circumstances the weight of the balloon when resting on land may be supposed to be about 3,300 pounds.

If we suppose 28 lbs. of sand are thrown overboard in ascending, the motive power will be $\frac{g}{115}$. The uniform motion will be $K v^2 = \frac{g}{115}$.

Under these circumstances, as far as my knowledge goes, it is 4 ft. per second. If we suppose $g = 32$ feet.

$$K v^2 = 16\ K = \frac{32}{115} \text{ and } K = \frac{32}{115 \times 16} = \frac{2}{115}$$

If a static effort of 20 lbs. in the vertical direction can be produced by the working of the vertical fan, it is easy to understand that the ascent can be stopped before the balloon has reached the level where the gas is beginning to escape by working in the proper direction for it. That effort is not too much for two men working on a fan which is suitably constructed.

The same thing can be said as to the descent of the balloon, but K is much larger, as the shape of the lower part is not so well suited for moving in the air as the upper half. With *appendice*, netting, ropes, and car, it exerts a resistance which is much larger and may be compared with the force exerted by a *parachute* descending in the air. The difference is very great, as I observed several times in my ascents that it was difficult to give the balloon a descending impulsion towards the land. I should not wonder if it was partly the cause of the resistance felt by Mr. Bowdler when moving his fan in the direction where it ought to have caused the balloon to descend; at least such is the opinion that I am in position to hold from the concise and imperfect narrative I found in the public papers.

W. DE FONVIELLE

Is the Rabbit Indigenous?

WOULD you permit me, through the medium of NATURE, to ask on what grounds the rabbit is considered not indigenous in this country? The best authorities on British and German Mammalia seem agreed that it is a native of the Mediterranean basin. On what facts or writings is this opinion based, and at what time was it introduced into Great Britain? I am very anxious to determine whether the above statements are founded on authentic documents or writings, or are merely suppositions which cannot be asserted with certainty. N.

Sept. 30

THE SOCIAL SCIENCE CONGRESS

THE friends of social science have had a most successful meeting this year at Glasgow, and in the various addresses and papers there has been afforded ample evidence that the importance of the introduction of more scientific knowledge into the heads and daily life of the people is becoming more and more widely acknowledged.

In the Health Section, Dr. Lyon Playfair in his address, after referring to Franklin's aphorism, "Public health is public wealth," pointed out that taking the smallest part of the money saving, it is obvious that money judiciously spent in sanitary improvement is not unproductive taxation, but capital bearing abundant interest; and he then gave an idea of the present sanitary chaos. "In England, at the present time, there is a casual agglomeration of 1,500 separate sanitary authorities, without system or cohesion. Their areas of administration are diverse in the extreme, being neither bounded by counties, parishes, nor natural watersheds; and their duties are divided without meaning between authorities in the same district. They have been lately put under medical officers of health without preparation or qualifications for their duties, some well paid and devoting their time to this important work, others having little more than nominal payment, and giving little more than nominal time to their important duties. Notwithstanding this too sudden and unprepared universal appointment of medical officers, yet in the administration of the Health Acts there has been recently manifested a disposition to 'distrust the doctors,' and to work the Acts, at least at head-quarters, by lawyers and other persons not connected with the medical profession. This is the old error of making common sense the fetish for worship, which Archbishop Whately and others have so effectively condemned. Even the most fervent worshipper of common sense as opposed to technical training never relies on it in important emergencies of his life. He goes to the lawyer to make his will or to convey property; he consults the parson on religious doubts when on the sick bed, and he does not spurn the doctor to cure him of his grievous ailment. But it is well known that the Local Government Board are afraid of the doctors in the administration of Health Acts. Who beside them possess the knowledge? I can testify, from an experience of thirty years in sanitary work—and impartially, because I am not in the medical profession—that there is not a class of men in the country who labour so zealously for the prevention of disease as the doctors, though their training hitherto has been cure, not prevention. Certainly their private interests have never been allowed to stand in the way of their efforts to uproot disease, although their living depends upon its existence. This unselfishness in the application of their science to prevention has always been to me a source of high admiration. Why, then, is there this vulgar distrust of the doctors in the administration of our Health Acts? Extend this prejudice against technical knowledge, and how absurd it would be. Would you improve the progress of telegraphy in this country by suppressing electricians, or the law and justice of the country by putting down lawyers? Would the Secretary at War promote the conduct of war by suspecting soldiers, or the First Lord of the Admiralty the efficiency of fleets by distrusting sailors? Would our railroads and harbours be better governed if engineers were held at a discount? But this is actually the state of things at the Local Government Board—the Health Ministry of the country. The Privy Council handed over to that Board Dr. Simon and his associates, with a wealth of medical experience in public hygiene. Ever since, that wealth has been locked away from public use. Certain I am that their experience could not have guided the Board in the utter confusion of organisation in regard to medical officers of health. They have been appointed without any system. Some have a small parish to attend to, others have a thousand square miles. The last are appointed for combined districts, but are managed by uncombined authorities, and have neither assistants to aid them nor power to enforce their decisions. The officers of health are without any definite rule for obtaining available knowledge of prevailing sickness, even when it is treated at the public expense within their own districts; and they are not, universally at least, informed of the deaths as they occur. The medical officers of health have been appointed without any examination on their knowledge of State medicine, and in the majority of cases they do not possess this knowledge. I am perfectly certain that this utter confusion could not have resulted had the Local Government Board consulted the experienced State medical officers belonging to them. This distrust of the doctors in higher administration is simply a general mistrust of science. And the time has now arrived when science must be trusted in government. Science is entering into the higher education of the country, and the prejudice against it among legislators, who were educated in classical universities, will in time be removed. For the progress of a country depends upon the progress of science, and the welfare of a nation is secured by the most intelligent application of science to its manufactures and to its government. The health of the country—and that governs the productive power of its people—depends as much upon the application of medical science as the working of a machine depends upon a good application of mechanical laws. To trust the whole administration of Health Acts to Poor-law inspectors and lawyers is an amazing example of unbelief in the first principles of the laws of health. The well-being of the people depends upon physical causes, which, when intelligently understood, mean physical science, and the trained physician is the natural and most intelligent agent for extending its knowledge and application to the prevention of disease. What we want in the future is not new law, but more efficient administration of existing law. To heap up new sanitary law on the decaying mass of undigested sanitary law, which already forms a dismal agglomeration, is like the practice of our ancestors, who thought that a few clean rushes thrown upon the corrupt mass of foul rushes on the floor sufficed for sanitary purposes. What we want is superior organisation and efficient administration of existing law. But, in our happy-go-lucky style of government, are we likely to get it? I doubt whether it will be wise to continue the Local Government as a separate department of the State. Its functions in reality appertain to the Home Office, which, when properly organised, should divide itself into two great departments, the one dealing with police and justice, the other with the physical interests of the people. One Secretary of State might have the supreme responsibility, but each of the divisions should be scientifically administered. It would be as absurd to put a man trained in physical science at the head of the branch of police and justice, as it is to put a man merely trained in law in charge of the physical interests of the people. It is an exploded fallacy that only lawyers are good men of business, and that scientific men are not. Is my friend Sir John Lubbock a worse banker because he is an eminent man of science? Is Mr. Spottiswoode a worse printer because he has distinguished himself as a physicist? Is Mr. Warren De la Rue a worse stationer because he is equally conspicuous as an astronomer and as a chemist? The Local Government of the country, in as far as it relates to the physical interests of the people, will remain an example of arrested development, unless science receives a recognised position in its administration."

In the Education Section there was nothing to call for notice in the address, but Mr. C. S. Parker drew attention to the Report of the Universities Inquiry Committee, and an interesting discussion followed.

The revenues of Oxford and Cambridge were reported by the Royal Commission appointed on the advice of Mr. Gladstone to be for the University, Colleges, and Halls of Oxford, 414,000*l*., or, including prospective increase in the next fifteen years, 538,000*l*.; and for the University and Colleges of Cambridge, 340,000*l*., or, including prospective increase, 380,000*l*. Making certain deductions from these totals, the net income was for Oxford 350,000*l*., and for Cambridge 300,000*l*.; or, deducting again what was levied by taxation from their own members, the net endowments for Oxford and Cambridge Universities respectively were 300,000*l.* and 250,000*l.* The largest item of expenditure was to Fellows of Colleges—Oxford, 102,000*l.*; Cambridge, 103,000*l.* The smallest item was for scientific institutions, being under 2,000*l.* for each University. Mr. Parker remarked that this was hardly what might have been expected by the general public. A satirical person might even suggest as an improvement the reversal of the order. Seriously, the distribution came to this. Taking the residents in the University at about 400 graduates and 1,400 undergraduates, almost all the former and about half the latter received substantial aid from endowments. Mr. Parker examined various schemes which had been put forward, and expressed an opinion that, provided the central life were maintained with vigour, it was much to be desired that the Universities should occupy themselves with extending their connections throughout the country. Looking to their examinations in every quarter, 44,000*l.* at Oxford or 33,000*l.* at Cambridge was by no means excessive for Scholarships and Exhibitions. Some Exhibitions should be separately competed for by the unattached students who were now pursuing their studies at the Universities with so much success and at so little expense—in many cases under 50*l.* a year. To carry out needed reforms some central guidance would be necessary, either from a body appointed by the Universities themselves or, more probably, from a Parliamentary Executive Commission. But if such a Commission should be appointed, it was desirable the public should understand that it had not to deal with a retrograde, obstinate, or lethargic corporation, but to co-operate with the Universities and Colleges. Oxford and Cambridge, in respect of learning, had not held their own against the great German Universities, but a change had begun, and in Mr. Parker's opinion they were yearly commanding more respect throughout Europe.

In the discussion which followed, the Hon. G. Brodrick deprecated an attempt to subsidise, at the expense of Oxford and Cambridge, wealthy towns which, had they existed in America, would long ago have provided Universities of their own. On no account should resources which ought to be concentrated upon Oxford be frittered away upon the great cities of England and Scotland.

Sir G. Campbell said that in his belief it was these endowments which seemed to render reform impossible. They acted as an immense bribe to a continuance of the old monkish form of education, which he believed to be a mere superstition. He believed that the devotion of the time and talent of our youth to the learning of the regular verbs of Greek and Latin, and even the higher mathematics, was a gymnastic, and not a practical education. If endowments were to be continued, they must be taken in hand and, apart from the wills of founders, devoted to those branches of education which experience showed to be really useful and practical.

An important paper On the place of technical education was presented to the Section by Mr. B. Samuelson, M.P. This we shall give on a future occasion.

PITCHER-PLANT INSECTS *

THE insect-catching powers of these curious plants, the Fly-traps (Dionæa), the Sundews (Drosera), and the Trumpet-leaves (Sarracenia), have always attracted the attention of the curious, but renewed interest has been awakened in them by virtue of the interesting experiments and observations on their structure, habit, and function, that have lately been recorded, and especially by the summing up of these observations in some charming papers by Prof. Asa Gray, which recently appeared in the *Nation* and the *New York Tribune* under the title of "Insectivorous Plants."

Through the courtesy of Dr. J. H. Mellichamp, of Bluffton, and of H. W. Ravenel, of Aiken, S.C., who have sent me abundant material, I am able to submit the following notes of an entomological bearing on the Spotted Trumpet-leaf (*Sarracenia variolaris*), which must henceforth rank with the plants of the other genera mentioned as a consummate insect catcher and devourer.

The leaf of Sarracenia is, briefly, a trumpet-shaped tube with an arched lid, covering, more or less completely, the mouth. The inner surface, from the mouth to about midway down the funnel, is covered with a compact decurved pubescence which is perfectly smooth and velvety to the touch, especially as the finger passes downward. From midway it is beset with retrorse bristles, which gradually increase in size till within a short distance of the bottom, where they suddenly cease, and the surface is smooth. There are also similar bristles under the lid. Running up the front of the trumpet is a broad wing with a hardened emarginate border, parting at the top and extending around the rim of the pitcher. Along this border, as Dr. Mellichamp discovered, but especially for a short distance inside the mouth, and less conspicuously inside the lid, there exude drops of a sweetened, viscid fluid, which, as the leaf matures, is replaced by a white, papery, tasteless, or but slightly sweetened sediment or efflorescence; while at the smooth bottom of the pitcher is secreted a limpid fluid possessing toxic or inebriating qualities.

The insects which meet their death in this fluid are numerous and of all orders. Ants are the principal victims, and the acidulous properties which their decomposing bodies give to the liquid doubtless render it all the more potent as a solvent. Scarcely any other Hymenoptera are found in the rotting mass, and it is an interesting fact that Dr. Mellichamp never found the little nectar-loving bee or other Mellifera about the plants. On one occasion only have I found in the pitcher the recognisable remains of a Bombus, and on one occasion only has he found the honey-bee captured. Species belonging to all the other orders are captured, and among the other species that I have most commonly met with, which, from the toughness of their chitinous integument, resist disorganisation and remain recognisable, may be mentioned *Asaphes memnonius* and *Euryomia melancholica* among Coleoptera, *Pentatoma ligens* and *Orsilochus variabilis*, var. *complicatus*, among Heteroptera; while kyatids, locusts, crickets, cockroaches, flies, moths, and even butterflies, and some Arachnida and Myriapoda, in a more or less inrecognisable condition, frequently help to swell the unsavoury mass.

But while these insects are decoyed and macerated in order, as we may naturally infer, to help to support the destroyer, there are, nevertheless, two species which are proof against its siren influences, and which, in turn, oblige it either directly or indirectly to support them.

The first is *Xanthoptera semicrocea* Guen., a little glossy moth, which may properly be called the Sarracenia Moth. It is strikingly marked with grey-black and straw-yellow, the colours being sharply separated across the shoulders and the middle of the front wings. This little moth walks with perfect impunity over the inner surface of the pitcher, which proves so treacherous to so many other insects. It is frequently found in pairs within the pitchers soon after these open, in the early part of the season or about the end of April. The female lays her eggs singly, near the mouth of the pitcher, and the young larva, from the moment of hatching, spins for itself a carpet of silk and very soon closes up the mouth by drawing the rims together and covering them with a delicate, gossamer-like web, which effectually debars all small outside intruders. It then frets the leaf within, commencing under the hood and feeding downward on the cellular tissue, leaving only the epidermis. As it proceeds the lower part of the pitcher above the putrescent insect collection becomes packed with ochreous excrementitious droppings, and by the time the worm has attained its full size the pitcher above these droppings generally collapses. This worm when full grown is beautifully banded transversely with white and purple or lake red, which Dr. Mellichamp poetically likens in brightness to the Tyrian dye. It is furthermore characterised by rows of tubercles, which are especially prominent on the four larger legless joints. It is a half looper, having but six prolegs, and keeps up, in travelling, a constant restless, waving motion of the head and thoracic joints, recalling *paralysis agitans*. The chrysalis is formed in a very slight cocoon, usually just above or within the packed excrement. The species, kindly determined by Mr. A. R. Grote, was many years ago figured by Abbott, who found it feeding on *Sarracenia variolaris*, in Georgia. Guenée's descriptions were made from these figures, for which reason I append [the more technical matter relating to the species is here omitted] a few descriptive notes from the living material. It feeds alike on *S. variolaris* and *S. flava*, and there are two broods each year, the first brood of larvæ found during the early part of May, the second toward the end of June, and disappearing with the dying of the leaves, the latter part of July.

---

* A paper read by Prof. C V. Riley, of St. Louis, Mo., before the American Association for the Advancement of Science, August 1874.

The second species is a still more invariable living accompaniment of both kinds of Sarracenia mentioned. By the time the whitish efflorescence shows around the mouth of the pitcher, the moist and macerated insect-remains at the bottom will be found to almost invariably contain a single whitish, legless, grub or "gentile," about as large round as a goose-quill, tapering to the retractile head, which is furnished with two curved, black, sharp hooks, truncated and concave at the posterior end of the body.

This worm riots in the putrid insect remains, and when fed upon them to repletion bores through the leaf just above the petiole and burrows into the ground. Here it contracts to the pupa state, and in a few days issues as a large two-winged fly, which I have described in the Transactions of the St. Louis Academy of Science as *Sarcophaga sarraceniæ*—the Sarracenia Flesh-fly.

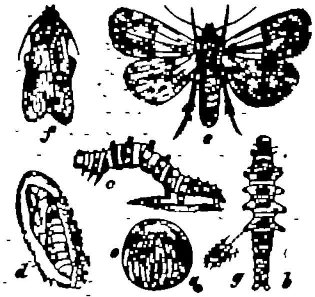


FIG. 1.—*Xanthoptera Semicrocea.* *a*, egg, enlarged, the natural size indicated at side; *b*, *c*, larva, back and side views, *d*, chrysalis: *e*, moth, normal form, with wings expanded, *f*, pale variety with wings closed

The immense prolificacy of the Flesh-flies, and the fact that the young are hatched in the ovaries of the parent before they are deposited by her on tainted meat and other decomposing or strong-smelling substances, have long been known to entomologists, as has also the rapid development of the species. The viviparous habit among the Muscidæ is far more common than is generally supposed, and I have even known it to occur with the common house-fly, which normally lays eggs. It is also possessed by some Œstridæ, as I have shown in treating of *Œstrus ovis*, the Sheep Bot-fly.

But the propensity of the larvæ for killing one another and their ability to adapt themselves to different conditions of food supply are not sufficiently appreciated. I have long since known, from extensive rearing of parasitic Tachinidæ, that when, as is often the case, a half-dozen or more eggs are fastened to some caterpillar victim only large enough to nourish one to maturity, they all hatch and commence upon their common prey, but that the weaker eventually succumb to the strongest and oldest one, which finds the juices of his less fortunate brethren as much to his taste as those of the victimised caterpillar. Or, again, that where the food-supply is limited in quantity, as it often is and must be with insects whose larvæ are parasitic or sarcophagous, such larvæ have a far greater power of adapting themselves to the conditions in which they find themselves placed, than have herbivorous species under like circumstances.

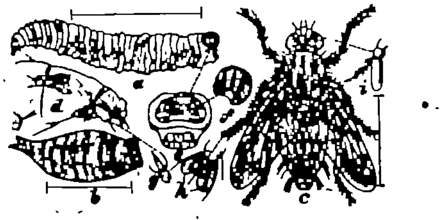


FIG. 2.—*Sarcophaga Sarraceniæ.* *a*, larva; *b*, pupa; *c*, fly, the hair lines showing average natural lengths; *d*, enlarged head and first joint of larva, showing curved hooks, lower lip (*g*), and prothoracic spiracle; *e*, end of body of same, showing stigmata (*f*) and prolegs and vent; *h*, tarsal claws of fly with protecting pads, *i*, antenna of same. All enlarged.

Both these characteristics are strongly illustrated in *Sarcophaga sarraceniæ*. Several larvæ, and often upwards of a dozen, are generally dropped by the parent fly within the pitcher; yet a fratricidal warfare is waged until usually but one matures, even where there appears macerated food enough for several. And if the Xanthoptera larva closes up the mouth of the pitcher ere a sufficient supply of insects have been captured to properly nourish it, this Sarcophaga larva will nevertheless undergo its transformations, though it sometimes has not strength enough to bore its way out, and the diminutive fly escapes from the puparium, only to find itself a prisoner unless deliverance comes in the rupture or perforation of the pitcher by the moth larva or by other means. This rupturing of the pitcher does not unfrequently take place, for Dr. Mellichamp writes under date of June 27 as follows:—"Most old leaves now examined—I might almost say all—instead of being bored, seem ripped or torn, as if by violence, apparently from without. You see occasionally shreds of the leaves hanging. Surely the legless larva of Sarcophaga cannot do this! What then—toads, or frogs, or crawfish abounding in these moist, pine lands? or rather is not the fat maggot the occasion of the visits of the quail which lately I have observed here?"

[Here follow some technical facts and descriptions of interest only to specialists.]

These two insects are the only species of any size that can invade the death-dealing trap with impunity while the leaf is in full vigour, and the only other species which seem at home in the leaf are a minute pale mite belonging apparently to *Holothyrus*, in the Gamasidæ, and which may quite commonly be found crawling within the pitcher; and a small Lepidopterous leaf-miner, which I have not succeeded in rearing. There must, however, be a fifth species, which effectually braves the dangers of the bottom of the pit, for the pupa of Sarcophaga is sometimes crowded with a little chalcid parasite, the parent of which must have sought her victim while it was rioting there, as larva.

But all other insects, so far as we know, tumble into the tube and there meet their death. The moth is doubtless assisted in walking within the tube by the spurs on the legs which it, in common with most other moths, possesses; while the Flesh-fly manages to hold its own by its widely extended legs and stout bristles. Dr. Mellichamp says that when disturbed it buzzes violently about, just as if an animated sheep-bur had fallen into the tube—not apt to go down, because it will hitch and stick, and finally, by main force, it generally emerges, but once in a while also succumbs.

Two questions very naturally present themselves here:—(1) What gives the Flesh-fly more secure foothold on the slippery pubescence than the common house-fly exhibits? (2) What enables the larva of the Flesh-fly to withstand the solvent property of the fluid which destroys so many other insects? I can only offer, in answer, the following suggestions: the last joint of the tarsus of the common house-fly has two movable, sharp-pointed claws and a pair of pads or "pulvilli." These pads were formerly supposed to operate as suckers, and all sorts of sensational accounts of this wonderful sucker have been given by popular writers, who forgot that there are any number of minute insects having no such tarsal apparatus, which are equally indifferent to the laws of gravitation so far as walking on smooth, upright surfaces, or on the ceiling, is concerned. In reality, these pads are thickly beset on the lower surface with short hairs, most of which terminate in a minute expansion kept continually moist by an exuding fluid—a sort of perspiration. Take the human hand, moistened by perspiration or other means, and draw it, with slight pressure, first over a piece of glass or other highly polished surface, and then over something that has a rougher surface, such as a planed board, a papered wall, or a velvety fabric, and you will experience much greater adhesion to the smoother objects, and may understand the important part which these moist pads play in the locomotion of the fly; they also act, in part, like the cushions of a cat's paw in protecting and preventing abrasion of the claws, which are very useful on the rougher surfaces, where the pads are less serviceable.

Now, compared with *Musca domestica*, the claws of *Sarcophaga sarraceniæ* are much the longest and strongest, and the pads much the largest, presenting three or four times the surface. These differences are, I think, sufficient to explain the fact that while the common fly walks with slippery and unsteady gait on the smooth pubescence (the retrorse nature of this pubescence sufficiently explaining the downward tendency of the movements), its sarcophagus congener manages to get a more secure footing;

for not only does the latter present a larger adhesive surface, but the longer claws are more likely to reach beyond the pubescence and the bristles, and fasten to the cellular tissue of the leaf beyond.

In answer to the second question, I can only say that there is nothing exceptional in the power of the larva to withstand the solvent quality of the fluid; it is, on the contrary, in accordance with the facts known of many species of Muscidæ and Estridæ, some of which, like the well-known horse-bot, revel in a bath of chyme, while others are at ease in the intestinal heat of other warm-blooded animals. It is also well known that they will often live for hours in strong liquids, such as alcohol and turpentine.

Conclusion.—To one accustomed to seek the why and wherefore of things, the inquiry very naturally arises as to whether Xanthoptera and Sarcophaga play any necessary or important rôle in the economy of Sarracenia. Speaking of the Sarcophaga larvæ, Mr. Ravenel asks, "May he not do some service to Sarracenia as Pronuba does to Yucca?" And if so, may not all this structure for the destruction of insects be primarily for his benefit? Can he be merely an intruder, sharing the store of provision which the plant, by ingenious contrivance, has secured for itself, or is he a welcome inmate and profitable tenant? Self-fertilisation does not take place in Sarracenia, and the possibility that the bristly Flesh-fly aids in the important act of pollination lends interest to the facts. No one has witnessed with greater pleasure than myself the impulse which Darwin has of late years given to such inquiries; but we should be cautious lest the speculative spirit impair our judgments or our ability to read the simple lesson of the facts. My own conclusions summed up are:—

1. There is no reason to doubt, but every reason to believe, since the observations of Dr. Mellichamp, that Sarracenia is a truly insectivorous plant, and that by its secretions and structure it is eminently fitted to capture its prey.

2. That those insects most easily digested (if I may use the term) and most useful to the plant are principally ants and small flies, which are lured to their graves by the honeyed path, and that most of the larger insects, which are not attracted by sweets, get in by accident and fall victims to the peculiar mechanical structure of the pitcher.

3. That the only benefit to the plant is from the liquid manure resulting from the putrescent captured insects.

[Mr. Ravenel, in making a transverse section near the base of the young leaf, noticed large tubular cells passing down through the petiole into the root, and much of the liquid manure may possibly pass through these into the root stalk.]

4. That Sarcophaga is a mere intruder, the larva sponging on and sharing the food obtained by the plant, and the fly attracted thither by the strong odour, as it is to all putrescent animal matter or to other plants, like *Stapelia variegata*, which give forth a similar odour. There is nothing to prove that it has anything to do with pollination, and the only insect that Dr. Mellichamp has observed about the flowers with any frequency, is a Cetoniid beetle, the *Euryomia melancholica*.

5. That Xanthoptera has no other connection with the plant than that of a destroyer, though its greatest injury is done after the leaf has performed its most important functions. Almost every plant has its peculiar insect enemy, and Sarracenia, with all its dangers to insect-life generally, is no exception to the rule.

6. That neither the moth nor the fly have any structure peculiar to them, that enables them to brave the dangers of the plant, beyond what many other allied species possess.

ON EVOLUTION AND ZOOLOGICAL FORMULATION[*]

IN the means which he has at his disposal for expressing the relative values of the facts of his science the chemist has an advantage over the zoologist which cannot be over-estimated. By a chemical rational formula it is possible to express, in a very small compass, facts of composition and decomposition, as well as many of the other relations borne by the constituents of a compound body one to the other.

In zoology formulation has received but little application; it has been employed to represent dental series and one or two other numerical points only; the cumbrous method of detailed verbal description being still resorted to in all cases, even when continuous observation has so accumulated facts, that it is almost impossible to retain the grasp of them without some auxiliary appliances. A method of zoological formulation, which, whilst expressing the facts of anatomical structure, attracts the attention to the relative importance of the observed differences, rather than to the details of the differences themselves, is a great desideratum; and it will be my endeavour on the present occasion to show how such a method can be made to assist in solving a problem so involved as the true affinities of a group of animals whose variable characters are fairly understood.

But the chemist has the atomic theory as a basis whereon to build; is there any principle in biology so inclusive as to yield a foundation on which to construct the desired system? Until the introduction of the theory of evolution and the doctrine of natural selection there was not. As long as the negative hypothesis of "special creation" held sway, the interest attached to the study of the mutual relations of organised beings was *nil*. No such relation could, in fact, have existed. But now, through the insight into nature arrived at by the all-embracing theories of Lamarck and Darwin—the Daltons of biology—the pedigree of the animal and vegetable kingdoms will form a problem which it will require many generations of the ablest zoologists to solve, even approximately, by the careful correlation of the undigested, unrecorded, and unobserved facts at their disposal.

Let us stop for a moment to glance at this doctrine of descent, in which, through the struggle for existence, by a process of natural selection, the fittest (for want of a better term) are said to survive. We may compare the living body of one of the higher animals to a cannon counterpoised on a Palliser gun-carriage, so fixed that it will hit a target situated at 1,000 yards distance. Before firing let marks be so made that the different parts of the whole engine can be afterwards adjusted to their former position. The gun is fired; the target is struck; a well-defined perforation or indentation is the result. A second similar shot is arranged for, by re-adjusting the engine with the assistance of the marks previously made; but on this occasion no direct aim is taken. The gun is again fired; but this time the target is missed, or it is hit in a different part. Why is this? It is because, in the former of the two firings, by the strain it caused to the whole machine, by the wear it produced in the rifling of the gun, and by the slight differences in the quality and quantity of the powder, the shot left the muzzle under different circumstances on the two occasions. The amount of this difference was sufficient, at the long range selected for illustration, to make the alteration in the course taken by the projectile perceptible. An external influence, the wind, is almost certain to have affected the result. This example shows how that minute differences, firstly in internal, and secondly in external circumstances, are sure to prevent the exact accordance of consecutive phenomena which might reasonably have been expected to be fac-similes one of the other.

As a general inference from every-day observation we are similarly led to expect that the offspring of living organisms will resemble their parent forms. But, as with the cannon, there are minor forces which in living beings come into play to produce slight changes in the progeny on all occasions. These changes are likewise of two kinds, depending on the circumstances connected with the parents themselves, and on those acting directly on the offspring from the time of its conception onwards. Amongst the former of these may be included differences in the actual and relative ages of the parents, both of which factors vary with each one of their progeny; their states of health, and their occupations. Amongst the latter are the habits and climate to which the offspring is subject. Causes of this nature, many of which are very incompletely understood, produce variations in the individuals of a species; and as the offspring resembles its parents, unless extra forces come into play to produce differences, the peculiarities of each variety are capable of transmission to the progeny. Thus, in course of time, strongly marked varieties of a species are likely to be developed; these give rise to others, until the descendants are very different from their ancestral forms. Time, however, besides continuing on the primitive stock and developing new varieties, produces other effects with equal certainty. Animals are dependent for their existence on a certain supply of organised food. Those living forms which furnish it have also been affected in a manner similar to their destroyers; like them, they have varied, and they have tended to become more numerous (the progeny in all cases being more numerous than the parents). The area of occupation being necessarily limited, and, as we are justified in assuming, fully stocked to commence with, the multiplication of the progeny develops a universal struggle for existence, one in which each individual, for self-preservation sake, participates; and in which the weakest goes to the wall. As in other contests, however, so in this, the race is not always to the swift, nor the battle to the strong, for many of the destroying causes are not those which are overt in their attacks. The sickly blade of grass, under the shelter of an overshadowing stone, protected from the browsing herd, fructifies and reproduces itself, whilst its free-growing neighbours form a delicious mouthful for the nibbling sheep. What amount of strength or courage can protect the leader of a flock from the ravages of an intestinal parasite? or prevent the largest individual of a flight of birds from being the most likely, on account of its greater superficial area, to be killed by a random gun-shot? Specialisation of function to resist special attack or to acquire special advantage, is, therefore, on account of the struggle for existence in conjunction with the tendency to vary, a factor of vitality. Specialisation in many directions is elaboration and progress so called; and as man possesses this in the most marked degree, he is considered to be the furthest removed from the living monad which gave him origin.

---

[*] The substance of a lecture, introductory to the evening class of Zoology, at King's College, Strand By Prof. A. H. Garrod, Fellow of St John's College, Cambridge.

The pedigree of vitality is evidently, therefore, the greatest problem of biology; for a full comprehension of it includes all the minor details of the science. How is this to be arrived at? From any collection of people which comprises nearly all the living representatives of a family, it is not difficult to obtain a large amount of information with regard to the ancestry of that family by oral interrogation. This will be facilitated by classing together in groups those of equal kinship, placing in the same sections brothers and sisters, in larger divisions those who are first cousins, and so on. It will not be hard to find who were the grandparents of each, some probably being present; the great-grandparents of most will have only been personally known to the older; and more distant relations of the same line, by hearsay alone. Pursuing the investigation, the linking of each retrograde step will be found more difficult, and the difficulty of identifying the ancestor common to them all will be almost insurpassable. When an old family has very few living representatives or none at all, the facilities for studying it will be proportionately diminished.

In zoology the method of investigation for the purpose of classification is very similar. Instead of direct interrogation, answers are arrived at by an appeal to facts of existing structure. Similarity in habits, distribution, and external characters separate off closely related forms from their more distant allies. To solve the more difficult problems of less intimate relationships, recourse must be had to internal characters in addition; to points of difference in osteological and soft-part anatomy, many of which can only be arrived at by prolonged dissection and the employment of every available opportunity.

The difficulty of appreciating the relative value of differences in any group of animals that is forming the subject of investigation, that of separating the realisation of the characters themselves, independently from the words necessary to express them, has led me in the course of my dissections to adopt a method of formulating my results in a manner which at once places them in a form available for ready comparison, and in an order of relative significance; in fact as rational formulæ, which differ in arrangement according to the phases of my general ideas. An example of the application and the applicability of this method may not be without interest, and this I will draw from the sub-order Psittaci, the Parrots.

The parrots form a well-marked, easily distinguishable group, with no outlying doubtful genera; and as with many other well-marked groups, such as the Rodents amongst mammals, and the Umbelliferæ amongst phanerogamic plants, the minor divisions are not so easily determinable. In fact, there is a very great uniformity in all the external and internal characters throughout the sub-order. There are, however, a few points in which they present variations, those best known being (1) in the vessels of the neck, (2) in the ambiens muscle, (3) in the furcula, and (4) in the oil-gland. I will notice each of these points shortly.

Firstly, with regard to the vessels of the neck. In most of the higher animals an artery, the carotid, runs up each side of the neck to supply blood from the heart to the head. In birds these vessels generally run in the middle line of the front of the neck, side by side and in contact. In some parrots, and in them only, whilst the right carotid pursues its usual course, the left, leaving its fellows, runs separately at the side along with the left pneumogastric nerve. In several groups of birds the right carotid is absent, the left alone remaining in its normal position. This is the case with one genus of parrots. Secondly, the little long and slender muscle, the ambiens, whose tendon in its unique course obliquely traverses the front of the knee capsule, is absent in some parrots, being present in others. Thirdly, the furcula or merrythought, which unites the two shoulders by an osseous bow, may be present or absent. Fourthly, the oil-gland, situated just over the tail, is wanting in some genera.

Omitting for the time being the case, which amongst the parrots is found only in the genus Cacatua proper, in which the left carotid alone is present, there are sixteen possible combinations of the four characters under consideration, of which six are found to exist. They are the following:—

1. The carotids are normal; the ambiens is absent; the furcula is present, as is also the oil-gland.—(PALÆORNITHINÆ.)
2. The carotids are normal; the ambiens is absent, as is the furcula, and the oil-gland is present.—(STRINGOPINÆ.)
3. The carotids run abnormally; the ambiens is present, as is the furcula and the oil-gland.—(ARINÆ.)
4. The carotids run abnormally; the ambiens is absent; the furcula and the oil-gland are present.—(PYHRRURINÆ)
5. The carotids run abnormally; the ambiens is absent, as is the furcula; the oil-gland is present.—(PLATYCERCINÆ.)
6. The carotids run abnormally; the ambiens is absent; the furcula is present; the oil-gland is absent.—(CHRYSOTINÆ.)

The facility for comparison afforded by a formulation of these results will be evident from an inspection of the following Table, in which the presence or absence of structures is represented by the signs + or —; in which the normal condition of the carotid arteries is indicated by a Roman 2, whilst its abnormal state is indicated by the same figure in italics. The relative positions of the four different anatomical facts is retained throughout :—

TABLE I.

	Carotids	Ambiens.	Furcula.	Oil-gland
(1) PALÆORNITHINÆ .	2	−	+	+
(2) STRINGOPINÆ . .	2	−	−	+
(3) ARINÆ	*2*	+	+	+
(4) PYRRHURINÆ . .	*2*	−	+	+
(5) PLATYCERINÆ . .	*2*	−	−	+
(6) CHRYSOTINÆ . .	*2*	−	+	−

On this arrangement, the Lories, belonging to the *Palæornithinæ*, their zoological formula is 2 − + + ; whilst that of *Cyanorhamphus*, which is one of the *Platycercinæ*, is *2* − − +. By this means the relations of the different groups to one another are readily recognisable.

Next, in the attempt to arrive at a correct detailed classification, the question as to the zoological formula of the ancestral Psittacine form must be one of primary importance. This can only be arrived at by a comparison of the other bird-types with that of the parrots. Taking the characters employed in Table I., and similarly formulating such birds as the fowl, duck, rail, stork, and cuckoo, they all agree in being represented by 2 + + + (1) ; others, like the kingfishers and hornbills, have the formula 2 − + + (2) ; whilst a third type, with only a left carotid, are included in the L − + + type (3). No others of importance exist. From which of them did that of the Psittaci spring? It must have been from one; and, peculiarly enough, there are genera to be found among them which closely approach all three, for—

The formula of *Pittacus* is *2* + + +
" " *Palæornis* " 2 − + +
" " *Cacatua* " L − + +

However, this only shows that the sub-order is a very ancient one, and has undergone changes analogous to the whole class *Aves*, and it does not complicate the problem in the least.

There are parrots with two normal carotids, *e.g.* the *Palæornithinæ* ; there are others in which the ambiens is present, *e.g.* the *Arinæ* ; most have a furcula and also an oil-gland.

Now suppose that when steam-engines were first introduced they had all been constructed with steam-whistles attached. Suppose that shortly afterwards several had been exported to different colonies, and that ever afterwards each colony had, with the originals as patterns, gone on constructing them for their own use, improving upon the original design as they thought best. Suppose that by certain individual manufacturers a gong was substituted for the whistle ; in others a bell, and in a third no sounding apparatus at all. A traveller going through the different countries at the present time would probably find whistle-engines wherever he went, though in different places gongs or bells will have replaced the whistle. Knowing nothing about the history of the steam-engine, is he not justified in inferring that it was originally constructed with a whistle ; for otherwise would it be likely that each colony should have independently employed the same method of signalling, when there were several to be chosen from ?

The naturalist, similarly, as an uninitiated looker-on at the contrivances of nature, finds the same type of structure running through forms not very intimately allied ; as, for example, two symmetrical carotids, in reptiles, mammals, and some birds ; or an ambiens muscle in the fowl, the eagle, the cuckoo, and the plantain-cutter. When, therefore, these fundamental arrangements are found to exist (though perhaps not combined in any one individual) in any well-defined group like the parrots, may it not be legitimately inferred that the ancestor of that group possessed them in their full and unmodified form ? Undoubtedly it may ; and on this principle we can almost certainly assume that the ancestral parrot possessed two normal carotids, an ambiens muscle, a complete furcula, and an oil-gland ; in fact, that its formula was 2 + + + ; and that all those species in which one or other of the included characters differ from this *type formula*, they do so on account of forces having modified the ancestral form. This line of argument therefore leads us to infer the extinction of the earliest form of parrot, unless some yet undissected genus is subsequently found to correspond with it ; and all the existing genera must be referred to collateral branches, in which at least one operation of modification has been accomplished. Those which have undergone no further change from the 2 + + + type are the *Palæornithinæ* (2 − + +), and the *Arinæ* (*2* + + +). Now the question presents itself, are all those with the modified carotid (*2*), members of a single stem, and those with the unmodified carotid (2) members of another, similar losses having occurred in both to develop the subjoined series ?

TABLE II.

2 − + +	*2* + + +
2 − − +	*2* − + +
L − + −	*2* − − +
	2 − + −

Or must those types be blended in which the formulæ correspond, irrespective of the carotids ? My placing the carotid index first expresses my belief as to its primary importance ; and this is because the conformation it represents is extremely peculiar and unique among birds, and is therefore less likely to have appeared except as the operation of a specially applied force on a single collection of individuals, the power of transmission being inherited. From this it may be inferred that the ancestral unmodified stem shortly sent off a branch represented by *2* + + +, which persists as such in the *Arinæ*. The main stem and its branch must each have, before long, had a branch of its own, represented by 2 − + + and *2* − + +, which persist as the *Palæornithinæ* and the *Pyrrhurinæ*. From the 2 − + + division sprang the 2 − − + (*Stringopinæ*), and the genus *Cacatua* (L − + −), as did the *2* − − + (*Platycercinæ*) and the *2* − + − (*Chrysotinæ*) from the *2* − + + division. The genus Cacatua is peculiar in having only the left carotid running normally, it must therefore be connected with the normal 2 carotid stem, and many Cacatinnæ, like the Cockateel and the Banksian Cockatoo, are represented by the formula 2 − + +. Some of the true Cockatoos, and some only, have no oil-gland.

My object in giving this somewhat lengthy illustration on the present occasion is to show how much facility a method of formulation affords in the working out of a minor problem of the great doctrine of heredity, such as the classification of the parrots. It makes comparison easy, it facilitates the performance of operations of addition and subtraction, bringing all the stages of the process before the mind's eye without any mental effort. Is it not one to be further developed ?

THE OPTICS OF THE SPECTROSCOPE

NOW that the Spectroscope is becoming an instrument of world-wide use, we think it will be not uninteresting to call attention to some few points that appear to be often overlooked in designing the instrument for various purposes ; and in order to ascertain the best arrangement, we cannot do better than analyse the effects produced in any spectroscope by varying the proportion of its parts. We must, however, premise by saying that the power of an instrument is not altogether dependent on the dispersive power of the prisms, but also on the width of the image of the slit in the eyepiece of the telescope of the spectroscope. To make our meaning clear, let us suppose that the slit is illuminated with a sodium flame, then the dispersive power of the prisms will produce in front of the eyepiece two images, or "lines," and with the same lenses the distance of their centres will depend upon the prismatic power; but it is clear that if the slit be widened, the two images will eventually widen until they touch each other or overlap. There is, then, the same dispersion, but less separation, than when we use the narrow slit; and it would follow from this that with an almost indefinitely small slit a prism of very small dispersion would give two separate images of a sodium-illuminated slit, which could be magnified so as to have their distance and width the same as would be given by using a wider slit and greater prismatic dispersion; but with an eyepiece of the large power required, the lines would be so diminished in brightness as to preclude this arrangement; and in order to see a spectrum as brilliant as possible, the eyepiece ought to be as low in power as possible consistent with reducing the cylinder of rays sufficiently small that they all enter the lens of the eye.

Let us now consider a spectroscope of any number of prisms having the focal length of the collimator the same as that of the telescope: then the image of the slit in the focus of the telescope will be of the same size and of the same brightness; for we must, for this consideration, omit the loss of light by reflection and absorption for the present, as the slit itself, which we will first suppose illuminated by sodium light, so that two yellow images of it will be visible in the eyepiece. Afterwards we will consider the case in which sun-light is used. First let us consider the effect of opening the slit wider, say double the width. By this means the images will be doubled in width and the separation diminished; the amount of light will be doubled, but will be spread over double the area, so the intensity of illumination will remain the same; therefore the slit should be as narrow as possible consistent with the image being wide enough to be visible. Secondly, let us double the length of the collimator. By this we halve the width of the image of the slit, so that the separation is increased, but the distance between the centres of the lines remains the same; the angle subtended by the *collimating lens* will in this case be halved, so that the amount of light passing will only be ¼ of the original amount, but as the image of the slit is reduced in like proportion, the intensity of illumination remains the same; *the effect in this case is* therefore the same as narrowing the slit, with the exception of the lines being shorter, thereby reducing the width of the spectrum—a matter generally of little moment, which can be altered at ease by lengthening the slit. Thirdly, we will double the diameter of the collimating lens, and with it that of the telescope and the prism. By these alterations the amount of light passing becomes quadrupled, therefore the images of the slit will be four times brighter; but the angle subtended by the telescope lens at the image is doubled, so that in order to get the whole of the light into the eye, the eyepiece must be placed at *half its distance from the image*, and be consequently doubled in power; the images will by this be reduced to their original brightness, but they will be magnified at the same time, and the distance from centre to centre doubled, the *separation doubled*, and the width of the images doubled, so that the slit may be reduced in width by ½, and yet leave each image as wide as at first. This will increase the separation between the interior sides of *the image still more, so that by doubling* the size of our lenses and prisms we have obtained double separation of centres of images, and more than double separation between images, which is just what would be produced by doubling the number or dispersive power of the prisms. It is therefore obvious that in dealing with a bright-line spectrum the power of the instrument depends on the size of the prisms as much as on their number, and an increase in number means an increase in the number of reflecting surfaces and loss of light, so that within practical limits an increase of size is the more preferable. Practically, on increasing the size of the collimating lens, as in this case the focal length should be increased, otherwise the lens is injured in defining power; the effect of *this increase is, as shown in the second case*, only equivalent to closing the slit, so it is better to lengthen the collimator instead of touching the slit; it is also better to increase the focal length of the telescope glass, thereby straining it less, and so increasing the size of the image of the slit without altering the power of the eyepiece.

Now let us consider the effect of these alterations on sun-light or other light giving a dark-line spectrum; and there is this difference between the consideration of this spectrum and the bright-line spectrum, for in this case the dark lines are not images of the slit, but intervals between them, and therefore their width and appearance depend not so much on the separation between the centres of the bright lines as on the separation of their adjacent sides, and with the same width of any two bright lines this separation or width of dark line does not vary in the same *ratio* as the *distance* between the centres of the bright lines, or as what is called the dispersive power, varies, but in a higher ratio. For example: suppose there appear in a spectroscope the two sodium-lines of appreciable width with the finest possible dark line between them; then, if the distance of their centres is doubled without increasing their width, the black line becomes increased by the increment of the distance of their centres, and with this increment the original dark line becomes much more than doubled; this will be seen better by drawing two bright lines of appreciable width on paper, and going through the process just mentioned. It is therefore *separation, according to our definition of the word, that is* required for dark-line spectra.

We will now consider the effect when using sun-light instead of sodium light in a similar manner to our first arrangement, *namely, in our normal* spectroscope, and let us widen the slit as we did before. Every image of the slit will then widen, and the separation between the sides of any two images will diminish, and therefore the dark lines will diminish in width as they are encroached on by the light on either side; the general spectrum will, however, increase in brilliancy, for although each image is only increased in size, as was the case with sodium light, still the images of each colour overlap, and so produce greater intensity. From this we gather that to obtain the greatest number and width of dark lines, the width should be as narrow as is compatible with sufficient illumination of the spectrum, *to show up the dark lines*; and so with a dark-line spectrum as with a bright-line one, the slit should be as narrow as possible.

Secondly, as with the sodium light, let us lengthen the collimator, *say double it*: then, as with the sodium light, the images will be halved and the separation increased, but only ¼ of the light passes, and the spectrum is reduced in width by ½, so that its brilliancy is ½ what it was originally; *or we may account for the decrease in brilliancy by* considering that although, as we showed in the case of the sodium light, the images of the slit are not reduced in brilliancy, still there is less overlapping and so less brilliancy. So we see that in order to keep a sufficient brightness of spectrum to show the dark lines, we must open our slit if we lengthen our collimator, and *vice versâ*, so that no power is gained by either of these methods, as was the case with the sodium light. Thirdly, we will double the diameter of the collimating lens, and with it that of the prisms and telescope object-glass. By this means the brilliancy only of the spectrum is changed, and this is quadrupled in the focus of the eyepiece, but the focal length must be halved in order to reduce the cylinder of rays small enough to totally enter the eye: this will magnify the spectrum to double its original size in every direction, and so double the width of the dark lines, but will produce no new ones ; it will also reduce the brightness of the spectrum to its original state. Now, when we were dealing with sodium light, we at this stage of proceeding halved the width of the slit, for the images of the slit had been doubled without their brightness being reduced, so we could halve them and bring them to their original size, and so increase the distance of separation still more ; but with a continuous spectrum, if we close the slit we shall, it is true, only decrease the width of each image of the slit and not their brightness, but we decrease their overlapping and so decrease the brilliancy of the whole spectrum, and this we cannot afford to do, as we have started with as narrow a slit as possible, and consequently with as small a brilliancy as possible consistent with showing the dark lines. We have therefore by this alteration of size of glasses doubled the width of dark lines originally visible, but we are not able to more than double the separation of any two images of the slit, as we did with the sodium light-images, by narrowing the slit in addition to increasing the distance of the centres, and therefore no new lines are produced ; in fact, the result of our change of arrangement has been the same as a simple magnification of the spectrum without a decrease in brilliancy ; and an increase of prismatic power is exactly similar in effect, as we shall presently show, though it seems at first untrue that increase of prismatic power will not increase the number of dark lines visible. Let us now double the number of prisms ; then the length of the spectrum will be doubled, and the distance of the centre of the images of the slit doubled, and therefore more dark lines may appear in addition to the original ones being widened, but the brilliancy of the spectrum has been halved, and in order to brighten the spectrum to the original state the width of the slit must be doubled, which exactly undoes all that the extra prisms have done in producing more lines ; for the images will expand and obliterate the newly-formed lines ; the original dark lines will, however, after the widening of the slit, be double their original width ; so that, as we have just stated, the increase of prismatic power will not make a greater number of dark lines visible. If we illuminate the slit more intensely, we may decrease the width of the slit and still retain our original brightness, and so obtain a reduction in the width of the images, and consequently a greater separation between their edges, and therefore an increase in the number of dark lines in addition to increase of width of those originally visible ; so that for the same kind of light the number of dark lines depends on the intensity of the illumination of the slit.

In dealing with the spectrum of an intense light like that of the sun, where there are a large number of lines, it is necessary to use an instrument of high power, whether in number or size of prisms, in order that the exceedingly fine dark lines produced by a low power may be, as it were, magnified without loss of light, which is, as we have shown, the effect of an increase of prismatic power ; and in order that these fine lines may become visible and sufficiently separated to render their identity for measurement or otherwise complete, so there may be an apparent increase in the number of lines by the invisible ones being rendered visible by magnification without loss of brilliancy in the spectrum.

But in dealing with light like that from a planet or the moon, where the slit must be so wide that few lines are visible, it can soon be tested in practice that the increase of power does not increase the number of lines. In examining the light of the moon or of a nebula, or any object having an appreciable diameter, any increase of telescopic power for the purpose of forming the image on the slit will not increase the useful brightness of the slit ; for, supposing a spectroscope be working to its greatest advantage on a telescope, then, if the diameter of the object-glass of the telescope be doubled, the angle it subtends at the slit will be doubled, and the cone of rays on the collimator side of the slit will have its base doubled, and therefore it cannot all pass through the collimating lens ; in fact, all the rays newly added by the increase of diameter of object-glass will be wasted against the tube of the collimator, and if we try to utilise these rays by increasing the size of collimating lens or decreasing its focal length, we shall also have to increase the power of the eyepiece to get all the rays into the eye, and so reduce the brilliancy of the spectrum to its original state. In the case of increasing the focal length of a telescope as well as its aperture, the brightness of the image on the slit is not increased, but only its size ; so the spectroscope is unaffected. But in the case of viewing the spectrum of a star, matters are altered, for the image of the star does not increase in size by increasing the focal length of the telescope together with its apertures ; but its brilliancy is increased, and therefore greater prismatic power can be used without increase of width of slit, and more dark lines seen ; so that for stellar spectroscopy an increase of telescopic apertures is a direct advantage. From the foregoing remarks we gain that in the construction of a spectroscope the eyepiece should be of as long a focus as possible, so as just to cause all the rays to enter the eye ; all magnification beyond this means loss of brilliancy, and if the spectrum appears insufficiently large an increase in size of the collimating and telescope lenses, together with the prisms, or an increase in the number of the prisms should be made, until the spectrum appears sufficiently large to suit the requirements of the observer. G. M. S.

THE SUB-WEALDEN EXPLORATION

THE Secretary of the Sub-Wealden Exploration has just issued his eighth quarterly report, in which he states that but little progress has been made during the last three months in consequence of the inability to procure lining tubes of the required size in sufficient quantity. The increased favour in which the diamond boring system is now held has caused a great demand for these tubes, and they are specially manufactured by an eminent Birmingham firm. The new pipes are required for the difficult process of enlarging and lining the bore-hole to the diameter considered requisite before attempting to withdraw the broken rods, &c. Mr. Willett says :—

"The engineers have no doubt whatever of their ultimate success, and as the extraction of the rods is not a matter involving the expenditure of our funds, we can only regret the loss of the long summer days, and take comfort from the assurance that, 'after the enlargement and lining is accomplished, there is a much better prospect of obtaining the desired depth of 2,000 ft. than there was a year ago that we should reach half the distance (1,000 ft), provided always that the *requisite funds be forthcoming*.'"

He is anxious to dispel what he terms "the delusion" that no more money is required from the public in consequence of a Government grant to the work having been obtained. He states that the Chancellor of the Exchequer, with laudable foresight and prudence, has promised to assist on certain conditions, to do which—

"I. We must spend 400*l*. in boring tubes, &c.
II. We must bore 100 ft., which will cost 300*l*. ; and *then*, and *not till then*,
III. We can draw 100*l*. from the Exchequer, and so on, claiming 100*l*. for every 100 ft. *actually* explored."

The third and last year of the tenancy for carrying out the work has been entered on, and therefore the necessity of speedily resuming the operations is at once seen. The financial position is cheering, the present balance being 594*l*. 7*s*. 9*d*. The honorary secretary says :—

"We are greatly indebted to the Right Hon. the Chancellor of the Exchequer, and to the Secretary of the Treasury (by whom the deputation was introduced), for having favoured us with an interview and patiently listened to our appeal for Government aid.

"The grounds of our claim were stated in our last report, and were naturally met by the remark that 'it would be a dangerous precedent to apply national funds for private purposes.' If all future applicants be compelled to

I. Raise 3,000*l*. by subscription;
II. Bore 1,000 feet; and
III. Obtain a memorial from the Royal Society, the Geological Society, and the Institute of Civil Engineers, stating that the prosecution of the work is of national importance;

they are not likely to be troublesome by their numbers, and the subject having been ventilated in the House of Commons, few reasonable minds will be disposed to doubt the discretionary wisdom of the grant with its attendant conditions.

"We are much indebted to William Topley, Esq., F.G.S., for having consented to visit Belfast, there to read our report and make personal application for additional aid from the Committee of Recommendation of the British Association for the Advancement of Science, and we are greatly encouraged by the response and the grant of 100*l*.

"The kind promise of Sir Charles Blunt to give us 50*l*. on reaching 1,000 ft. has been faithfully performed; so also will Mr. Warner's promise of 300*l*. when we reach 2,000 ft.

"In scientific research it has often occurred that the benefits accruing have been indirect and unexpected by the promoters. Not only have the rich beds of gypsum been made known, and, in consequence, are now in actual process of development, but the new facts ascertained by our work have thrown some considerable light (and that of an encouraging nature) on the problem of the feasibility of constructing a sub-marine tunnel between England and France.

"The motives which actuate our friends to subscribe are various and sometimes novel, as, for instance, one writes: 'I enclose my mite—besides the objects stated, a shaft is doubtless a safety valve against earthquakes.'"

The report concludes by thanking the directors of the London, Brighton, and South Coast, and the South Eastern Railways, for their assistance in the work, the latter company having, in addition to granting other privileges, in the use of their line, forwarded a cheque for 50*l*. The kindness of the Earl of Ashburnham, the Rev. T. Partington, and many others is acknowledged, and the honorary secretary concludes his report with an earnest hope for further encouragement, and that the results will prove that their labour has not been expended in vain.

NOTES

THE inhabitants of a vast district of London have had during the past week an opportunity of studying the phenomena of explosions on a large scale, and of noticing how closely they approach those of earthquakes in the sequence of long-rolling waves of the solid earth, loud noises, and finally long continued tremulous motion and more subdued sounds. If we could have announced last week that 100 barrels of gunpowder would explode in London, locality not defined, on a given day, the inhabitants would probably have been alarmed, many would certainly have visited their country friends; but our Government have for years been warned that such an occurrence might happen seeing that there is no legislative enactment to ensure care, and yet they have let such a state of things continue! We have it on the authority of the *Times* that the *Tilbury* might have had 500 barrels on board instead of 100, and it is clear that these might have exploded in a locality where the consequent destruction of life and property would be fearful to contemplate. It appears that, bad as are the regulations for the transport of gunpowder on board ship, there is little or no provision for the prevention of accidents at places where powder is received and delivered in large quantities. In reporting on this branch of the subject in 1865, Major-General Boxer instanced the case of Isleworth. He says:—"The powder wharf at Isleworth affords a good illustration. This wharf is situated in the town of Isleworth, on the banks of the Thames; on an average as much as 600 barrels per week is shipped there, the wharf is surrounded by houses, and the sacrifice of life would be fearful in the event of an explosion." Major Majendie, in a report to Government two years ago, wrote:—"I am quite sure that if the public were at all aware of the extent to which gunpowder is handled in large quantities, without any special regulations, in the middle of the metropolis and of large cities, they would be seriously alarmed, and would demand the adoption of measures for removing so patent a danger." Truly we are a practical people, and much superior to the Germans, who only allow the transit of large quantities of gunpowder through populous districts under military escort.

THE effect of the explosion in the Zoological Gardens was not so serious as might have been expected from the proximity of the gardens to the scene of the disaster, but several of the animals were thrown into a state of great agitation. The elands, antelopes, and deer, particularly, were very much startled, and were found running round their enclosures in a state of great alarm. The elephant, hippopotamus and rhinoceros, and the giraffes were very much excited, and the birds became much alarmed. About a dozen of the smaller birds escaped through a hole in the glass roofs of the aviary, caused by the concussion, but two or three returned during the day. The blankets and coverings were shaken off the snakes, but fortunately none of the glass in their cages was fractured. It was fortunate, too, that none of the large carnivora were liberated.

WE referred some little time ago to the fact that a sum of about 30,000*l*. had been left to the "London Academy of Sciences." We hear that already several societies and institutions have sent in, or are thinking of sending in, claims. It is stated, however, that the Royal Society, which certainly is the nearest approach to the institution in Signor Ponti's mind, has not applied. The Royal Society is of course a mere private body, and might well be held to be justified in refusing to incur the responsibility of distributing a large sum for the furtherance of science; but the miserable chaos in our scientific arrangements is none the less strongly brought out by the present juncture. In England, truly, Science is a body without a head!

FRANCE, Germany, and Austria are vying with each other in astronomical activity. In the grounds of the Paris Observatory a 4-ft. Foucault mirror is being erected, and M. Le Verrier has already obtained a grant for a 30-in. refractor. The Vienna Observatory is also making arrangements for the reception of a telescope of similar aperture. Messrs. Merz have nearly completed a lens of 20 in. aperture, for the University of Strassburg. In France, the newly-created *Ecole Speciale des Hautes Etudes* is being taken advantage of to form a school of Astronomy; in Germany and America many such schools exist already, thanks to the rational administration of their Observatories, the assistants in which are the pupils, friends, and potential successors of the director.

M. DESJARDINS, one of the head officials in the Ministry of Public Instruction, has been ordered by the Minister to inspect the meteorological service of the Observatory and to report upon its present condition.

THE Government of Newfoundland has determined to take steps for the protection of the seal fisheries, by preventing vessels from leaving port before a certain date, and are anxious to induce the Governments of other countries, whose subjects are engaged in other fishings, to take similar measures in respect to vessels leaving their respective ports. It is hoped thereby to establish an international convention, which will have the effect of giving the seals at least another month after the breeding season, in which the young may increase in size and value, and thus the fearful slaughter of immature seals which has threatened the total extermination of the animal will be checked.

The ordinary business of the Paris Academy of Science was entirely suspended at the meeting on September 28, owing to the death of M. Elie de Beaumont. The burial took place on the 25th, the entire Academy attending their *confrère* to the grave. Funeral addresses were delivered by M. Dumas on behalf of the Academy, by M. Ch. Sainte-Claire Deville on behalf of the Mineralogical Section, by M. Daubrée in the name of the School of Mines, and by M. Laboulaye in the name of the French College.

The President and Council of the Royal Society of Edinburgh, "impressed with the conviction that the progress of the sciences demands, and has long demanded, fuller and more exact tables of logarithms than any which at present exist," have memorialised Sir Stafford Northcote with the view of inducing the Government to print a nine-figure table of logarithms of numbers from unity to a million, part of which has been already calculated by Mr. Sang, who has carried a fifteen-figure table up to 300,000. The subject of undertaking the publication of logarithm tables—so long as the number of figures does not exceed ten, the limit of utility—is one well worthy the attention of the Government; but in the present case there are several reasons why, if the application is refused, the loss to science will not be so great as some might think. In the first place, a table of 1,800 large pages, whether in one, two, or three volumes, will be so unwieldy that, notwithstanding the ease of the interpolations, it would probably be very seldom used by computers; and secondly, because all who require more than seven figures will, no doubt, prefer to use ten, and consult the existing works. In fact, nearly all computers would, we believe, employ Vlacq or Vega in preference to the proposed table. Mr. Sang, in the pamphlet which accompanies the memorial, makes a remarkable error when he intimates that the great French tables have not been used to verify any seven-figure table, so that "up to the present moment we have no verification of Vlacq's great work." In point of fact, the whole of Vlacq was read with the copy of the French tables at the Paris Observatory, by M. Lefort, and the results of the comparison are published in vol. iv. of the "Annales de l'observatoire de Paris." Almost all the errors found by Mr. Sang by means of this table are among those there given by Lefort, and anyone who chooses can, without much expenditure of trouble, render his copy of Vlacq all but free from error—much more accurate than any new table could possibly be.

Attention is being again directed to the cultivation of Cinchonas in St. Helena, which at one time promised so well, but which has, owing to changes in the Government, been allowed to lapse into decay. Some seven or eight years since, when the island was under the governorship of Sir Charles Elliott, Dr. Hooker strongly advised a trial of the plants to be made, and plantations were formed at Diana's Peak. So satisfactory was the progress of the plants that the Government consented to the selection of a gardener from amongst the best or most intelligent of those to be obtained at Kew. One was chosen and sent out, and, to quote from a recent number of the *St. Helena Guardian*, "All went well so long as Sir Charles Elliott was at the head of affairs: plantations were formed, and the gardener, Mr. Chalmers, was treated as one having the charge and responsibility of an important colonial experiment, and the plants grew well up to the time when Sir Charles Elliott left and Admiral Patey was appointed in his stead. The new governor at once decreed that the plantations at Diana's Peak were a mere foolish waste of money, that the gardener sent out from Kew would be better employed at Plantation House, and employed he was, chopping firewood and raising beans, peas, and radishes, and selling them for the benefit of the privy purse of Government House, and the Cinchona plantations were left to go to ruin or to flourish by their own unaided vigour, as the case might be." The result of three years' cultivation and three years' subsequent neglect seems to be, that although there are a few dead and sickly plants, nearly all the trees are in full vigour and luxuriant growth. There are about 300 flourishing plants, many of which are twelve feet high, and three to four feet in diameter. The bark is also a quarter of an inch thick, and has an intensely bitter quinine taste. Many of the plants in the St. Helena plantations have the lower part of their stems bound up with moss in order to try if the bark would not swell and increase more rapidly, but it has had the effect of showing, by the bursting out of rootlets from the part so bound with damp moss, that the plant throws forth roots readily from the bark, and thus may be easily propagated by cuttings. The Government has recently been again in correspondence with Dr. Hooker on this subject, and it is to be hoped that the cultivation will be again renewed and prosecuted continuously.

We have been requested to publish the following extract of a letter recently received from Cambridge (Mass.):—"We have been very much amused by the pertinacity with which our friends on your side are determined to provide us with a successor to Prof. Agassiz, to fill a vacancy which has no existence and has been filled long since. Alex. Agassiz takes his father's place in the Museum, assisted by Count Pourtales and Col. Lyman, who attend more to the details; and the professorship has been divided, and separate professors appointed, one for zoology and one for geology. There is now therefore no vacant chair in Harvard, so far as I know, although Prof. Wyman is lately deceased; but I think he relinquished his duties some time since, on account of ill health. So I do not perceive the slightest chance for the numerous successors proposed in England or elsewhere."

The French Geographical Society sent a deputation to Vienna to offer its official congratulations to the Hungro-Austrian Polar Expedition. It was very cordially reciprocated by Payer and his associates.

An International Horticultural Exhibition will take place at Antwerp, commencing on April 4, 1875, under the auspices of the Royal Society of Horticulture and Agriculture of that town, and promises to be on a large scale. An International Exhibition of Fruits will also be held at Amsterdam in October 1875, under the management of an influential committee.

We learn from the *Belgique Horticole* that that cryptogamic pest the *Puccinia malvacearum* is making sad havoc among the mallows and hollyhocks in some parts of Belgium.

We are informed that the *Phylloxera* has appeared in Switzerland, and that the delegates of the wine-growing cantons met on Monday last, the 5th inst., to consider the best means of preventing its extension.

Some excitement has been aroused in New York by the discovery of a rich vein of hæmatite iron ore in the heart of the city by some workmen who were digging foundations for a new building. The vein, which is 30 ft. wide, was found at a depth of only 4 ft. from the surface.

Prof. Bentley and Mr. Trimen are engaged in the production of a voluminous work on the medicinal plants of the world.

As there are not many works devoted to this important branch of botanical science, we shall gladly welcome this book, as from the well-known abilities of the authors we have every reason to anticipate that it will at once take a prominent position among standard works on this subject. It will be copiously illustrated.

Dr. Humphrey, F.R.S., the Professor of Anatomy at the University of Cambridge, gives notice that his course of lectures on Practical Anatomy will begin on Thursday, Oct. 8, at 9 A.M., and be continued daily. The course on Anatomy and Physiology will commence on Friday, Oct. 23, at 1 P.M., and be continued on Tuesdays, Thursdays, and Saturdays, at the same hour. This course is intended for students of natural science as well as for students of medicine, and gentlemen not requiring certificates are at liberty to attend without fee.

A telegram received at Hull from the captain of the schooner *Samson*, which has just returned from a cruise in the Arctic regions, announces the discovery of large beds of coal at Spitzbergen.

The volcanic soil in the neighbourhood of Vesuvius is stated to be an antidote to the potato disease and other fungoid diseases of plants. It is also said that it is found of great value in the treatment of *Phylloxera*; this, however, remains to be proved.

The inaugural meeting of teachers, students, and friends of the College for Men and Women (with which is incorporated the Working Women's College) will be held at St. George's Hall, Langham Place, on Monday, October 12. The chair will be taken by Mr. Thomas Hughes, Q.C., at 8 P.M. The College is established to afford to men and women occupied during the day a higher education than has generally been within their reach. The classes are taught for the most part gratuitously, and the design is that mutual help and fellowship may be promoted between all members of the College, teachers and students, by the educational work in the classes and the social life of the coffee-room.

The Statistical Society, that has occupied apartments at No. 12, St. James's Square, for nearly thirty years, as a tenant of the London Library, has recently changed its quarters to the house formerly occupied by the Principal of King's College, and its present address is Somerset House Terrace, Strand, W.C., London (King's College entrance). This change has become necessary by the simultaneous growth and development of both the London Library and the Statistical Society, and is therefore a matter of congratulation to both institutions.

We have to record the death, on Saturday last, of Dr. William W. Fisher, Downing Professor of Medicine in the University of Cambridge since 1841, when he succeeded Dr. Cornwallis Hewett. Dr. Fisher, from being an undergraduate, first at Trinity and then at Downing College, became Fellow of the latter, and remained so until he accepted his Professorship. He was formerly physician to Addenbrooke's Hospital, and till his death steward and librarian of his College. The stipend of the Professorship is 400*l.* a year with a residence in Downing College; it must be refilled within two months of a vacancy occurring.

The opening meeting of the approaching session of the Medical Microscopical Society will take place at the Royal Westminster Ophthalmic Hospital on Friday, the 16th inst., at 8 P.M.

Alphonse de Candolle, of Geneva, whose first botanical memoir was published forty-five years ago, has been elected one of the eight foreign associates of the Academy of Sciences at Paris, in the place of Agassiz.

M. Melsens, a member of the Royal Academy of Belgium, has published a pamphlet describing the verification of lightning-conductors, as practised by him in several monuments of Brussels, for ascertaining if they are in a position to conduct electricity into the humid parts of the earth. The experiments were tried with a Hely machine, and with Daniel elements and galvanometers. In the first instance fifteen of the pupils of the Veterinary School were employed to ascertain if they had received any shock.

The reptiles of the French Museum have been removed to their new home. The boas had been previously overfed, so that they were as easy to handle by the keepers as so many cables. The crocodiles were most unmanageable, and it was necessary to use nets in order to catch them. Some of the venomous snakes were tempted by food offered to them into small cages, in which they were shut up hurriedly, and removed. Now everything is right, and the several inhabitants of the reptile menagerie are happy and contented in the new building which will be formally opened within a few days by the Minister of Public Instruction.

The death is announced of one of the most prominent and indefatigable members of Col. Gordon's expedition, Mr. Anson, who succumbed to an attack of fever on the 27th of July. The deceased was the son of Admiral Anson, and was highly esteemed by Col. Gordon for his zeal and usefulness.

M. X. Ducloux has discovered and given the name of *Rivotita*, or Rivotite (in honour of the memory of M. Rivot, late Professor of the School of Mines, at Paris), to a new kind of mineral, which is found in small irregular masses, dispersed in a yellowish-white chalk, upon the western slope of the Sierra del Cadi, in the Spanish province of Lerida.

We have received the Sixth Annual Report of the Cardiff Naturalists' Society, and are pleased to notice that the year just closed has proved most successful; the number of members has increased from 190 to 288, and the finances of the society are in a good condition. During the past year, the committee have organised for the first time a series of scientific and literary lectures, which have been largely successful.

The additions to the Zoological Society's Gardens during the past week include two Call Ducks (*Anas boschas*), European, presented by Mrs. Wilson; four Little Bustards (*Tetrax campestris*), European, purchased; a Rhesus Monkey (*Macacus erythraeus*) from India; a Solitary Tinamon (*Tinamus solitarius*) from South America; three Lesser Pin-tailed Sand Grouse (*Pterocles exustus*) from North Africa; two Cornish Choughs (*Fregilus graculus*), European, deposited.

SCIENTIFIC SERIALS

The *Journal of the Chemical Society* for August contains, in addition to the usual abstracts from foreign journals, the following papers communicated to the Society:—On ipomoeic acid, by E. Neison and James Bayne. This acid, obtained by the action of nitric acid upon jalapin, has been shown by the authors to be identical with sebacic acid. This conclusion has been arrived at from a comparison of the solubility, melting-point, and composition of the acids. The potassium, barium (normal and acid), lead, and silver salts have been prepared and examined.—Note on New Zealand kauri gum, by M. M. Pattison Muir. The gum is an exudation from a coniferous tree (*Dammara Australis*) imported into this country for the purpose of making varnish. The action of different solvents and of various reagents has been tried, from which it appears that the substance is a mixture of resins with a true gum, and is therefore to be classed as a gum-resin.—On certain compounds of albumin with the acids, by George Stillingfleet Johnson. Compounds with nitric, hydrochloric, sulphuric, orthophosphoric, metaphosphoric, citric, oxalic, tartaric, and acetic acids have been obtained. The method of preparation consists in dialysing white of egg over dilute solutions of the acids. The action of water heated above its boiling point upon these compounds has been studied, and special experiments undertaken to ascertain the nature of the action exerted by the dialyser in producing the compounds. The author concludes that the following points have been probably established by his experiments:—(1) The existence of definite compounds of albumin with the acids in simple molecular ratios (the probable formula of the nitric acid compound may be given by way of illustration—$C_{72}H_{112}N_{18}SO_{22}2HNO_3$). (2) The applicability of dialysis to the ready and accurate preparation of these compounds. (3) Probable correctness of the formula of Lieberkuhn, Loew, and Liebig for albumin.—On a simple method of estimating urea in urine, by Dr. W. J. Russell and S. H. West. The authors make use of the well-known action of hypochlorites and hypobromites upon urea:—

$$CO(NH_2)_2 + 3HClO = CO_2 + 3HCl + 2H_2O + N_2.$$

The most advantageous solution for this purpose is formed by dissolving 100 grms. of caustic soda in 250 c.c. of water, and adding 25 c.c. of bromine. A measured quantity of urine is introduced into a bulb-tube of particular form, and then allowed to mix with excess of the hypobromite solution. The reaction is complete in from ten to fifteen minutes in the cold, but on warming is complete in five minutes. The apparatus is so constructed as to permit the collecting of the evolved nitrogen in a tube which is graduated in such a manner that the amount of gas read off gives at once the percentage of urea in the urine employed. A remarkable fact observed by the authors is that in the reaction between urea and the hypobromite there is invariably eight per cent. less nitrogen evolved than that required by theory. With uric acid 35 per cent. of the nitrogen is suppressed, with hippuric acid 82½ per cent., and with creatinine 25 per cent.—The concluding paper is on Dendritic spots in paper, by Huskisson Adrian.

THE *Scottish Naturalist* for October contains the following articles:—On the Salmonidæ of the Eden, Fife, by P. Walker, F.G.S.E.—Notes on the entomology of Shetland, by the Rev. J. Blackburn and C. E. Lilley.—Concerning aquaria, by Dr. Peter White.—Tenthredinidæ in Rannoch, by P. Cameron.—Notes on Lepidoptera in Kirkcudbrightshire, by W. D. Robinson Douglas.—The occurrence of rare birds in the Carse of Gowrie, by Col. Drummond Hay.—Several articles on the fungi of Scotland, and a continuation of the lists of Scottish insects, by F. Buchanan White, M.D., and D. Sharp, M.B.

THE *Bulletin de la Société d'Acclimatation de Paris* for June opens with a paper by M. Ch. le Doux, on the yield of the cocoons of the new silkworm *Attacus aurota*, and on the best mode of winding the cocoons which are pierced by the moth on its escape, or left unfinished by the silkworm.—M. P. Chappellier gives an interesting account of the growth and preparation of saffron, with special reference to the production of new species of crocus and other saffron yielding plants in France.—The East Indian possessions of Holland, Java, Sumatra, Borneo, the Moluccas, and other islands, are the subject of a paper by M. E. Prillieux, who gives a valuable list of their principal productions, industrial and otherwise. This list includes no less than 247 timber-producing plants grown in the East Indies.—Among fishery questions perhaps no subject is of more importance than the effect produced by the use of fixed engines. Contributions to the literature on this point are made by M. Renibaud in a letter addressed to the Minister of Marine, and by Dr. Turrel, delegate of the society at Toulon.—M. Delidon continues his researches on the change of colour in the silk produced by silkworms, caused by a change of food.—M. Kemmerer, the inventor of cemented tiles for catching oyster-spat, announces that he has relinquished his patent rights in the invention which has been so successfully adopted by oyster-culturists.—The Minutes of the monthly meeting of the society, detailing the various experiments made by its members, are very interesting, including observations on many diverse subjects.—The Agricultural Society of France has offered a prize of 1,000 francs each for the best method of artificial irrigation, for the best means of destroying the *Phylloxera vastatrix*, for the best economical means of utilising the beetroot and its products, for the best horse-breeding establishment in Finistère, Côtes-du-Nord, Morbihan, Ille-et-Villaine, and Loire Inférieure, and for the educational establishment which shall have taken the best means to instruct in agriculture and horticulture.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Sept. 1.—In a former number of this periodical an instrument called the nephoscope was described by Herr Braun, intended to serve for measurement of the direction and apparent velocity of clouds. He has now made an addition to the nephoscope, by which the absolute height of clouds may be determined without any calculation, and thence also their absolute velocity. Such an instrument has been wanting in meteorology, and will certainly be useful. Of course the cloud chosen for measurement must be isolated and not very high, and the place of operation must be elevated and so placed as to command a view of the cloud's shadow. It is the height of the cloud above its shadow, not above the place of observation, which is obtained. The old method may still be followed with the nephoscope, but it is more laborious. The instrument is minutely described with reference to an annexed woodcut.—Among the *Kleinere Mittheilungen* we have a notice of Prof. Lommel's book, "Wind und Wetter." His explanation of the curves of storms issuing from the region of trade winds is somewhat as follows:—The rotation of the cyclone being in the N.E. trade wind from N. through W. and S. to E., the N.E. trade wind opposes and retards the S.E. portion, but accelerates the N.W. portion of the whirl. Thus the pressure will be least in the N.W., greatest in the S.E. quarter, and progress will be made towards the N.W. Arrived in the region of variable winds, the course will be changed according to the direction of the prevailing wind. Supposing a storm to be on the western coasts of Europe, and the most common wind, S.W., to be blowing, the direction of progress will be E. or E.S.E., and this is actually the course commonly taken by European storms.

Memorie della Societa degli Spettroscopisti Italiani, July.—This number contains an announcement of the death of Paolo Rosa at Rome on the 11th of July, and a short statement of his scientific labours; it also contains a letter from P. Rosa on the connection of solar activity and rainfall, and a paper by the same author on the identity of photospheric and magnetic phenomena in connection with the proper motion of the sun. Tables are given showing a corresponding variation of the magnetic variation with the changes in the solar diameter, there being an 11-year period of both, and also a secular period of 66⅔ years. Secchi writes that the spectrum of Coggia's comet corresponded with that of a hydrocarbon, and that the continuous spectrum observed therewith was due to reflected sunlight, since it disappeared on interposing a Nicol's prism. Prof. Bredichin fixes the lines at 5633, 5164, and 4742 of Angström's scale; and Tacchini at 6770, 5620, 5110, and 4800; the longest was 5620, and the brightest 5110. The chromosphere as seen in January last is shown in a drawing by Tacchini, and he adds that he has seen the chromosphere steadily at an altitude of 3° from the horizon, and when the limb of the sun was very unsteady in a simple telescope.—Tacchini sends a note that four bolides travelling together entered our atmosphere on the 27th of July, the position and drawing is given; they were seen for 40 seconds.—A number of drawings of Coggia's comet are sent by Tacchini, with a descriptive statement. Wright adds a note that the comet's light was polarised.

Journal de Physique, tome iii., Nos. 29, 30.—In these two numbers is an article by M. Berthelot on the principles of Thermo-chemistry. The study of the evolution of heat in chemical combinations is a new branch of science belonging partly to physics and partly to chemistry, and the number of facts already observed is sufficiently numerous to indicate certain laws which M. Berthelot proceeds to set forth. It is, he premises, admitted that in a chemical combination the molecules hit sharply one against another and give off heat, just as when a hammer strikes a bar of iron. From a study of the relations between the amount of heat evolved and the amount of work done, it is possible to establish some theorems of Thermo-chemistry. 1. First principle. The amount of heat given off in any reaction is a measure of the chemical or physical work done in that reaction. Several examples are given. 35·5 grs. of chlorine unite with 1 gr. of hydrogen and form hydrochloric acid, giving off 22 calories. The compound occupies the same volume as its component parts. Here the physical work is *nil* and the chemical is 22 E (E being the mechanical equivalent of heat.) Again, 8 grs. of O unite with 1 of H to form water. At ordinary temperatures the heat evolved is 34·5 calories. But there is a change from gas to liquid. Part of the work is chemical, part physical. It is shown, then, that the temperature affects the amount *of heat evolved*; this is due to the physical work of exterior pressure. All computations should, when possible, be made with both the components and the compound in the state of gas. This is not always possible; hence the importance of the second principle. 2. If a system of simple or compound bodies taken in certain conditions lead to physical or chemical changes which bring about a fresh state without giving rise to any mechanical result, then the heat given off or absorbed by these changes depends entirely on the first and last conditions of the system. The intermediate states do not affect it. For example: $C+O_2=CO_2$ gives 47 calories. Or, $C+O=CO$ gives 34·5; and then, $CO+O=CO_2$ gives 12·5, and 34·5 + 12·5 = 47 as before. We have not space to notice the five "consequences" from this principle. 3. Third principle. Every chemical change effected without the intervention of any external energy leads to the production of a body, or system of bodies, which give off more heat. For example: $Sn+O=SnO$ gives off in formation 36·9 Cal.; $Sn+O^2=SnO_2$ gives 72·7. Some compounds cannot be formed by their own energy—*e.g.* acetylene is formed by the union of C and H, but it requires the energy of an electric current to induce it.—M. Laurent describes a new saccharometer.—M. Mascart contributes an article on the annealing of glass, having special reference to the preparation of objectives.—M. Blavier's paper, continued from No. 28, is concluded.—M. Marcy describes a new chronograph of a small size convenient for holding in the hand, based on the principle of Duhamel's.—There is also an article by M. Thurot on Galileo's experiments on weight.

Annali di Chimica applicata alla Medicina, No. 2, vol. lix., August.—The present number begins with a paper in pharmacy On the reactions of morphine, from researches by Hermann, Kelbrunner, Siebold, and Schneider.—In dietetics, Prof. Fr. Selmi contributes a paper entitled "New Study of Milk," and there is also one by Dr. Martin on *koumiss*, a vinous liquid obtained by the fermentation of milk.—In toxicology there is a paper by Pietro Albertoni and Filippo Lussana on the physiological criterion for medico-legal proofs of poisoning.—In physiology, Prof. G. Sèe furnishes a paper on the action of the salts of potassium.—Under "Varieties" there are the following papers:—On the culture of *Eucalyptus globulus*, by Dr. Lodeganck.—The blue colour of linen used for medical purposes, by Louquet.—Use of chloroform and ether for stupefying bees, by Chalfon.—Phenol-camphorated oil for the gummy disease of fruits, by Dr. F. F. Adorni.—Bisulphite of soda as an antichlore for bleaching, by Dr. T. Schuchardt.—The part concludes with a biological notice of Justus Liebig, by G. Ruspini, and a review of the fourth part of the *Annuario delle Scienze Mediche*, published by Drs. P. Schivardi and G. Pini.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences, April 7.—Dr. Jos. Leidy in the chair.—"The Blue Gravel of California," by E. Goldsmith. Under the name of "Blue Gravel" the California gold miners, and especially the placer miners, understand a rock which underlies the gold-bearing alluvium of that State and part of Nevada. It is stated that whenever the gold-bearing sand in many localities in the two above-named States has been removed by the well-known washing process, the "blue gravel" appears. It also contains gold, which cannot, however, be extracted by washing, the stream of water being unable to disintegrate the rock, which is a compact composite one, and not, as the name "gravel" would imply, a loose material. This so-called "blue gravel" is composed of two ingredients widely differing in age, namely, of pebbles cemented together by a lava. The pebbles are of all sizes. From the general appearance I infer that some of these pebbles were derived from the sedimentary rock, slate, and others from hornblende rock. Entirely different in general aspect from the rounded pebbles is the other part of the rock, which I have already stated to be a lava. This appears to envelop the pebbles completely. This lava is very brittle, so much so that the preparation of a thin plate for microscopical observation is impossible. The hardness is equal to apatite. The most distinguishing crystallisation within the lava mass is a black mica, which is probably biotite. I noticed also a few grains of quartz, as well as flattened grains of bright yellow gold. The conclusion at which I arrive is that the so-called "blue gravel" of California is a conglomerate of pebbles of various kinds cemented together by an acidic lava in which crystals of mica (biotite) and grains of gold are imbedded. How the gold came into the lava is a question of some difficulty. Whether it was mingled with the pebbles before the lava ran over the bed, or whether the gold was ejected from the volcano, I am not able to decide.

April 14.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy called attention to the "Bulletin of the United States Geological and Geographical Survey of the Territories, No. 2," presented this evening. It contains a "Review of the Vertebrata of the Cretaceous Period found west of the Mississippi River," by Prof. Cope. In this article he was quoted in such a way as not fairly to express his original meaning. Thus, on one page reference is made to the proceedings of this Academy, in which it is intimated that *Thespesius occidentalis* was referred to the Mammalia, and regarded, perhaps, as a Dinosaurian. "In the Proceedings I have rather expressed the reverse, as I state of *T. occidentalis*, among the collection of vertebrate remains, are two apparent caudal vertebræ and a first phalanx of some huge animal, which I suspect to be a Dinosaurian, though they may have belonged to a mammalian. I may add that Prof. Cope, quoting from the same Proceedings, indicated that I had referred Ischyrotherium to a Sirenian. This is so, but Prof. Cope appears to have overlooked the more full account of the animal in the Trans. of the Am. Phil. Soc., in which, though I still refer it with doubt to the mammalia sirenia, I state that the remains may have belonged to an aquatic reptile."

May 12.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy gave a notice of some new freshwater Rhizopods, having all the essential characters of Amœba, but, in addition, provided with tufts of tail-like appendages or rays, from which he proposed to name the genus Ouramœba. It is possible that Ouramœba is the same as the Plagiophrys of Claparede, though the description of this does not apply to that.—Dr. Chapman made the following remarks on the generative apparatus of the *Tebennophorus carolinensis*:—He found both ova and spermatozoa in the organ regarded first as simply the ovary, later as the testicle.

May 19.—Dr. Kenderdine in the chair.—"The Veins of Beech and Hornbean Leaves." Mr. Thomas Meehan said that De Candolle had noticed some years since a difference in the venation between the *Fagus ferruginea* and *Fagus sylvatica*, the common American and European beeches. In the American beech the lateral veins were said to terminate in the apex of the serratures, in the European they terminate at the base of the sinus. As the statement stood, it conveyed the idea that there was a marked difference in structure between these two allied species, which did not, however, exist, as growing in this country the leaves of the European beech are almost entire; the lateral veins, in approaching the margin of the leaves, curve upwards, and connect with the lateral above them, forming a sort of marginal vein near the outer edge of the leaf. The veins of the American beech curve upward in the same way, but are easily arrested, and this sudden cessation of growth produces the serra, which are slightly curved upwards.—"Direct Growth Force." Mr. Meehan referred to some potatoes exhibited by him to the Academy a few years ago, in which the stolons of a grass had penetrated through from one side to the other, preferring, as it would seem, to go through such an obstruction to turning aside to avoid it. A potato was a rather rough-surfaced body. He now exhibited a similar case, only the obstruction was the round smooth root of an herbaceous peony. Though not more than one-third of an inch thick and round, a stolon of *Triticum repens*, the common couch grass, had pushed itself through.

May 26.—Dr. Ruschenberger, president, in the chair.—On report of the committee to which it had been referred, the following paper was ordered to be published:—"Description of two new fossil shells of the Upper Amazon," by T. A. Conrad.

CONTENTS

PAGE
PROFESSOR HUXLEY AT MANCHESTER 455
THE REPORT OF THE METEOROLOGICAL COMMITTEE 457
GEOLOGY AND AGRICULTURE 458
OUR BOOK SHELF 459

LETTERS TO THE EDITOR:—

Migration of Birds.—ALFRED R. WALLACE 459
Regular Motion in Clockwork.—J. HOPKINSON (*With Illustration*) 459
Rainbows.—Prof. P. G. TAIT, F.R.S.E. 460
U.S. Weather Maps.—W. CLEMENT LEY 460
Aurora.—J. RAND CAPRON 460
The Cry of the Frog.—F. T. MOTT 461
The Woolwich Aëronautical Experiment, II.—W. DE FONVIELLE . 461
Is the Rabbit Indigenous? 461
THE SOCIAL SCIENCE CONGRESS 461
PITCHER-PLANT INSECTS. By Prof. C. V. RILEY (*With Illustrations*) 463
ON EVOLUTION AND ZOOLOGICAL FORMULATION. By Prof. A. H. GARROD 465
THE OPTICS OF THE SPECTROSCOPE 467
THE SUB-WEALDEN EXPLORATION 469
NOTES 470
SCIENTIFIC SERIALS 472
SOCIETIES AND ACADEMIES 474

THURSDAY, OCTOBER 15, 1874

THE UNIVERSITIES COMMISSION REPORT

I.

THE publication of this Report has been awaited with an interest which rarely attends the issue of a Blue Book: and though the Commissioners have taken two years and a half over their labours, the result, both in its matter and its form, fully justifies their apparent delay. We have here presented to us in a concise and intelligible shape, the entire financial affairs of the Universities of Oxford and Cambridge with their Colleges. The whole property of these wealthy institutions, its sources and its application, the probability of its increase, and their annual income and expenditure, are now for the first time laid before the public.

It is in itself no small thing that these ancient corporations, with one single exception, should have been prevailed upon without direct Parliamentary pressure to reveal their most cherished secrets: for it should be remembered that only twenty years ago the first University Commission failed totally in its attempt to extract similar information from the unreformed Colleges, and that even up to the present time not even a University man had materials from which to form a reasonable conjecture as to the wealth of any other College than that of which he might happen to be a Fellow. It must be admitted that the Colleges come out from this ordeal of publicity with a better show than even their friends had anticipated. To produce the elaborate returns which the Commissioners required, an immense amount of additional labour has been thrown upon the College Bursars, who, as the Report bears witness, are not over-abundantly requited for the large amount of work they do as managers of landed estates and treasurers of the general accounts. The Master of Sidney Sussex College, Cambridge, who is also Bursar, has alone proved recalcitrant; but as to all the rest, it is pleasant to read the language in which the Commissioners express their gratitude for the ready assistance which they have received, and the spirit of marked courtesy with which they have been met. It had been generally anticipated that the system of managing estates through these amateur land-agents would not be proved to be economical, but the facts seem to have been unexpected even by the Commissioners, who report that the cost of management of the whole external income averages somewhat under 3*l.* per cent. They also state that they have no reason to believe that the condition of the estates let at rack rent is below the average, though probably less outlay is made than by private landlords who improve their properties. There is, however, a large quantity of land still let on the old system of beneficial leases, concerning which method of letting a clear description is given in the Report, and the agricultural condition of this land is confessedly bad; but this mode of tenure is universally condemned, and is in process of being rapidly extinguished.

With regard to the internal income and its expenditure, the Commissioners are unable, owing to the complicated and varying manner in which these accounts are kept, to arrive at any general conclusions, but they condemn in unhesitating terms the custom which appears to prevail everywhere at Cambridge, by which the payments of the undergraduates as caution money and tuition fees are made directly to the College tutor, who not unnaturally is induced to regard this arrangement as a private affair between himself and his pupil, so that in some cases information on this subject has been unwillingly given, and in some others altogether withheld. Some disapproval also is expressed of the general mode in which the College accounts are kept, which may be explained by the circumstance that they were never intended for publicity, and in many instances retain the old Latin nomenclature. It was only in a few cases that a correctly drawn balance-sheet was obtainable, and in some cases the accounts of Trust funds are not kept properly distinct, and the balances of such accounts seem to be occasionally borrowed for the general purposes of the College, and no interest allowed. It is further observed that there is no case of audit by a professional auditor. These criticisms, after all, are upon minor matters, but they have a certain importance as showing that the Commissioners have been both searching in their inquiries and fearless in their comments, and also because from the terms of their appointment they were not permitted to make any more general recommendations with regard to the wide question of the uses of academical endowments.

The real value of this Report of course lies in the long and elaborate array of figures which it gives, and in its impressive totals. A mine of reliable information is here afforded to University reformers and all those who are interested in the advancement of science, from which they may learn how vast is the wealth at their disposal, and from which they may securely draw materials for a comprehensive scheme. The total income of the Universities and Colleges in the year 1871, which is the year which the Commissioners have fixed upon for all their calculations, amounted to no less than three quarters of a million, and the number of undergraduates was about 3,500. Of this total, Oxford receives the larger share by more than 70,000*l.*, while the number of undergraduates is just equal. Another calculation gives the external income of Oxford (by which term the Commissioners intend the revenue from endowments) at 336,000*l.*, and the internal income of the Oxford Colleges, which is mainly derived from dues, fees, and profits of establishment, at 58,000*l.*, besides tuition fees at 30,000*l.*, whereas the sum of only 41,000*l.* is spent in scholarships, exhibitions, &c. These figures should be compared with those lately given to the public in the Fifth Report of the Royal Commission on Scientific Instruction, which dealt with such voluntary institutions as University and King's Colleges, London, and Owens College, and from such comparison the conclusion will inevitably be drawn that University education is capable of being made self-supporting, and that the University endowments can only be justified in so far as they encourage, not the teaching, but the advancement of learning and science.

This conclusion is also strongly supported by a more minute examination of the figures in this Report bearing on the income and expenditure of the several Colleges. It has long been well known that the educational utility of a College bears no relation to the value of its endowments, but this truth can now be enforced by very definite examples. King's College, Cambridge, has a revenue from endowment of 34,000*l.*, and has from 20 to 30 undergraduates; Exeter College, Oxford, has an endowment of less than 6,000*l.*, and educates 180 undergraduates, from whose payments a profit is derived which exceeds the external income by nearly 6,000*l.* A comparison also between Corpus Christi College, Oxford, where the sum of 975*l.* in the year is actually drawn from the endowments to pay the balance of the kitchen and buttery accounts, and Keble College, which has absolutely no endowment and yet exhibits a profit of 500*l.* on the year's account, equally teaches the lesson that out of tutorial and other fees, and fair boarding charges, an unendowed institution is capable of paying its own way, even in the face of competition with extravagant endowments. It appears, then, that by far the larger portion of the University endowments are not applied to educational purposes proper, nor apparently is it desirable that more should be devoted to that object, so that those are proved to be not far wrong who have urged that all this wealth is in the main wasted upon sinecures, and is readily available for the direct advancement of science and pure learning. At Oxford, the Heads of Houses and Fellows, more than two-thirds of whom are non-resident, receive yearly 131,000*l.*, and the remainder of the revenue is expended upon various minor charges which are probably inseparable from the possession of large landed estates and considerable buildings and grounds. It is then to this 131,000*l.* that the attention of reformers must be directed, and the question of its proper uses becomes the more important when it is added that the Commissioners anticipate that in the next fifteen years the Colleges will receive an increase, due to the falling-in of beneficial leases, of 123,000*l.* It is probable, nay, almost certain, that this total will be considerably increased, partly by a general rise in the value of land, and partly through building leases, so that by the end of this century Oxford will have a yearly sum of 260,000*l.* upon which there is no present claim of more importance than those of Headships and Fellowships. If the revenues of Cambridge are treated according to the same principle of calculation, the amount paid to scholars and expended in general purposes being knocked off and the probable increase being included, the Colleges of that University will have at the same date about 160,000*l.*, so that Oxford will then appear even more than now the richer of the two. In our next article we shall point out how this large sum might be yet further increased, if the connection with the Church of England, which has always hampered to so great an extent the usefulness of the Colleges, were finally severed, and if all the academical endowments were to be strictly applied to academical purposes; but even without such severance a sufficient surplus is shown to induce the much-desired agreement as to its proper application, so that it may not continue to be wasted, nor diverted, as some have suggested, to the great towns; a mode of action which will induce all towns to do nothing in order that the Universities may eventually help them, and more than ever justify the French criticism that our Universities are nothing more than *Hautes Lycées*, instead of being, as they should be, the active centres of learning and research. It is to a Liberal Ministry that we owe the Commission which has yielded this valuable Report, but according to all appearances it will be a Conservative Government that must undertake the more important task of inaugurating the work of fundamental University Reform.

METEOROLOGICAL REFORM

WE would invite our readers' attention to an article which appears in this number of NATURE on the necessity for placing Physical Meteorology on a rational basis.

It forms the substance of a paper brought before the recent meeting of the British Association by Col. Strange, who has taken, as our readers well know, a very prominent part in the reconstruction of British Science, and to whom we are indebted for the present very earnest and lucidly argued protest in favour of a more rational way of treating meteorology.

He begins by dividing meteorology into two branches—one of these relating to weather and climate and their effects on organised life; while the other deals with the great physical motions of the atmosphere and with their causes.

To know beforehand the climatic peculiarities of a watering-place or country seat is no doubt of much importance, especially for an invalid who is in search of a healthy locality, but this does not constitute physical meteorology. It forms, we venture to think, a more important and certainly a more difficult branch of inquiry to study the earth's envelope as a whole, to ascertain the nature of the movements to which the moveable parts of it are subject, and finally to investigate the physical causes of these. It is in this latter aspect that the meteorology of the day is so lamentably deficient. The great fault in the present system has been well put by Col. Strange.

Two things have been taken for granted by meteorologists. In the first place, it has been imagined that the sun affects the earth in only one way, namely, by means of its radiation; and secondly, they appear to have taken for granted that this radiant influence is a constant quantity. So much indeed have these most important factors been overlooked, that we believe no systematic effort has yet been made to measure the sun's radiant influence, and indeed no proper instrument has yet been devised by which this can be done in a satisfactory manner. Without doubt the great question for meteorologists is that put by Col. Strange: "Is the sun a constant quantity?"

Now, if the evidence in favour of the sun's constancy were absolutely overwhelming, even then the present system would be at fault, inasmuch as no systematic attempts have been made to measure the strength of the solar influence: but how much more is the system deficient when it refuses to investigate an influence which is certainly predominant and most probably inconstant. To give our readers some idea of the evidence in favour of this latter assertion, let us quote the following words from a letter contained in a report presented to the British Association by a committee appointed to consider the question of scientific organisation:—

"Recent investigations have increased the probability of a physical connection between the condition of the sun's surface, and the meteorology and magnetism of our globe.

"In the first place, we have the observations of Sir E. Sabine, which seem to indicate a connection between sun-spots and magnetic disturbances, inasmuch as both phenomena are periodical, and have their maxima and minima at the same times.

"On the other hand, the researches of Messrs. Baxendell and Meldrum appear to indicate a relation between the wind-currents of the earth and its magnetism, and also between the earth's wind-currents and the state of the sun's surface.

"In the last place, the researches of Messrs. De la Rue, Stewart, and Loewy appear to indicate a connection between the behaviour of sun-spots and the positions of the more prominent planets of our system. Whatever be the probability of the conclusions derived from these various researches, they at least show the wisdom of studying together for the future these various branches of observational science."

A further report by the same committee tells us that "It is not enough to obtain a record of the areas and positions of the various sun-spots. The velocity of cyclonic motion, the chemical nature of the outbursts, the disposition and character of the faculæ and prominences, and many other points, are, as shown by Mr. Lockyer, even more characteristic of the nature of solar action than the magnitude of the spotted area, and are equally worthy of a careful and constant study."

The evidence in favour of some strange and variable action of the sun may, perhaps, be compared to that in favour of the existence of America before that continent was discovered by Columbus; and it might have been thought that in an age like the present the difficulty of organising solar research would be very much less than that experienced by Columbus in organising an American expedition; but this is not the case. Indeed, it is not very creditable to the scientific authorities of this country that they have not entered more readily into a subject of this importance. From the quotations given above, our readers will see that this is not the first time the subject has been brought before the British Association.

A large and influential committee, embracing in its ranks many of the most distinguished members of the Association, endeavoured to bring the subject before the Administrative Council of that body, but did not succeed in getting the Council to move in the matter, or even to pronounce any opinion upon the subject. We hardly think this was proper treatment of an important problem, which had found such advocates as Col. Strange, Drs. De la Rue and Joule, Messrs. Baxendell, Lockyer, and Meldrum, as well as the general support of the most distinguished physicists of the country.

Clearly Col. Strange is right in supposing that a problem of this importance and extent can be properly undertaken only by Government. His remarks on this subject are so well put that we will report them here. Starting with the fundamental axiom that private enterprise should be allowed the most perfect freedom from interference or competition by the State, he lays down the following conditions for Government action in any scientific problem:—

(*a*) That the probable results of the research be beneficial, in the widest sense of that term, to the community at large, or to the various departments of the State.

(*b*) That the research is too costly or commercially too unremunerative to be undertaken and vigorously prosecuted by individuals.

(*c*) That the research requires continuous, uninterrupted work, extending over very long periods, and conducted by systematically organised establishments.

It will at once be seen that all these conditions apply to solar research; and the Governments of other nations have already perceived the fact. Our readers are aware that the Governments of France and America have it in contemplation to establish solar observatories, and a recent number of this periodical informs them that the German Government has already founded one on a large scale, of which it is possible the illustrious Kirchhoff will be the Director.

In conclusion, as we are advocating a question of reform, it is desirable that something in the shape of practical suggestions should be made. Now, in the first place and with reference to the great problem of Solar Physics, we think that this should certainly be encouraged by the establishment of a distinct central observatory devoted to the purpose; for it would be manifestly unfair to our illustrious Astronomer Royal to throw upon him the additional burden of an institution so very different from that over which he now presides.

In the next place, with reference to photographical delineations of the solar disc, Col. Strange has made a suggestion, at once so practical and simple, that we cannot do better than quote his own words:—

> "With respect to sun-spot researches, it fortunately happens that the photographic records need not be all taken at the same station. The record of one day taken in England can be combined with the record of the next day taken at the other side of the globe. Hence, in order to obtain this daily record it is only necessary to select a certain number of stations in localities such that there shall always be clear weather at one of them. India offers peculiar facilities for such a selection of stations, owing to the great variety of climate to be found in that country during the same period of the year. Perhaps four or five such stations would suffice for India, and if absolute continuity of record could not be obtained by them, the deficiencies could easily be made good by stations in our colonial possessions."

It is well known how slowly such things march in this country; nevertheless we look with much confidence to the forthcoming report of the Royal Commission appointed to investigate matters of this nature, and to urge upon Government such means as they consider shall tend to the advancement of science and to the good of the country.

BALFOUR STEWART

VAN DER WAALS ON THE CONTINUITY OF THE GASEOUS AND LIQUID STATES

Over de continuiteit van den gas- en vloeistoftoestand. Academisch proefschrift. Door Johannes Diderik van der Waals. (Leiden: A. W. Sijthoff, 1873.)

THAT the same substance at the same temperature and pressure can exist in two very different states, as a liquid and as a gas, is a fact of the highest scientific importance, for it is only by the careful study of the difference between these two states, the conditions of the substance passing from one to the other, and the phenomena which occur at the surface which separates a liquid from its vapour, that we can expect to obtain a dynamical theory of liquids. A dynamical theory of "perfect" gases is already in existence; that is to say, we can explain many of the physical properties of bodies when in an extremely rarefied state by supposing their molecules to be in rapid motion, and that they act on one another only when they come very near one another. A molecule of a gas, according to this theory, exists in two very different states during alternate intervals of time. During its encounter with another molecule, an intense force is acting between the two molecules, and producing changes in the motion of both. During the time of describing its free path, the molecule is at such a distance from other molecules that no sensible force acts between them, and the centre of mass of the molecule is therefore moving with constant velocity and in a straight line.

If we define as a perfect gas a system of molecules so sparsely scattered that the aggregate of the time which a molecule spends in its encounters with other molecules is exceedingly small compared with the aggregate of the time which it spends in describing its free paths, it is not difficult to work out the dynamical theory of such a system. For in this case the vast majority of the molecules at any given instant are describing their free paths, and only a small fraction of them are in the act of encountering each other. We know that during an encounter action and reaction are equal and opposite, and we assume, with Clausius, that on an average of a large number of encounters the proportion in which the kinetic energy of a molecule is divided between motion of translation of its centre of mass and motions of its parts relative to this point approaches some definite value. This amount of knowledge is by no means sufficient as a foundation for a complete dynamical theory of what takes place during each encounter, but it enables us to establish certain relations between the changes of velocity of two molecules before and after their encounter.

While a molecule is describing its free path, its centre of mass is moving with constant velocity in a straight line. The motions of parts of the molecule relative to the centre of mass depend, when it is describing its free path, only on the forces acting between these parts, and not on the forces acting between them and other molecules which come into play during an encounter. Hence the theory of the motion of a system of molecules is very much simplified if we suppose the space within which the molecules are free to move to be so large that the number of molecules which at any instant are in the act of encountering other molecules is exceedingly small compared with the number of molecules which are describing their free paths. The dynamical theory of such a system is in complete agreement with the observed properties of gases when in an extremely rare condition.

But if the space occupied by a given quantity of gas is diminished more and more, the lengths of the free paths of its molecules will also be diminished, and the number of molecules which are in the act of encounter will bear a larger proportion to the number of those which are describing free paths, till at length the properties of the substance will be determined far more by the nature of the mutual action between the encountering molecules than by the nature of the motion of a molecule when describing its free path. And we actually find that the properties of the substance become very different after it has reached a certain degree of condensation. In the rarefied state its properties may be defined with considerable accuracy in terms of the laws of Boyle, Charles, Gay-Lussac, Dulong and Petit, &c., commonly called the "gaseous laws." In the condensed state the properties of the substance are entirely different, and no mode of stating these properties has yet been discovered having a simplicity and a generality at all approaching to that of the "gaseous laws." According to the dynamical theory this is to be expected, because in the condensed state the properties of the substance depend on the mutual action of molecules when engaged in close encounter, and this is determined by the particular constitution of the encountering molecules. We cannot therefore extend the dynamical theory from the rarer to the denser state of substances without at the same time obtaining some definite conception of the nature of the action between molecules when they are so closely packed that each molecule is at every instant so near to several others that forces of great intensity are acting between them.

The experimental data for the study of the mutual action of molecules are principally of two kinds. In the first place we have the experiments of Regnault and others on the relation between the density, temperature, and pressure of various gases. The field of research has been recently greatly enlarged by Dr. Andrews in his exploration of the properties of carbonic acid at very high pressures. Experiments of this kind, combined with experiments on specific heat, on the latent heat of expansion, or on the thermometric effect on gases passing through porous plugs, furnish us with the complete theory of the substance, so far as pure thermodynamics can carry us.

For the further study of molecular action we require experiments on the rate of diffusion. There are three kinds of diffusion—that of matter, that of visible motion, and that of heat. The inter-diffusion of gases of different kinds, and the viscosity and thermal conductivity of a gaseous medium, pure or mixed, enable us to estimate the amount of deviation which each molecule experiences on account of its encounter with other molecules.

M. Van der Waals, in entering on this very difficult inquiry, has shown his appreciation of its importance in the present state of science; many of his investigations are conducted in an extremely original and clear manner; and he is continually throwing out new and suggestive ideas; so that there can be no doubt that his name will soon be among the foremost in molecular science.

He does not, however, seem to be equally familiar, as yet, with all parts of the subject, so that in some places, where he has borrowed results from Clausius and others, he has applied them in a manner which appears to me erroneous.

He begins with the very remarkable theorem of Clausius, that in stationary motion the mean kinetic energy of the system is equal to the mean virial. As in this country the importance of this theorem seems hardly to be appreciated, it may be as well to explain it a little more fully.

When the motion of a material system is such that the sum of the moments of inertia of the system about three axes at right angles to each other through its centre of mass does not vary by more than small quantities from a constant value, the system is said to be in a state of stationary motion. The motion of the solar system satisfies this condition, and so does the motion of the molecules of a gas contained in a vessel.

The kinetic energy of a particle is half the product of its mass into the square of its velocity, and the kinetic energy of a system is the sum of the kinetic energy of its parts.

When an attraction or repulsion exists between two points, half the product of this stress into the distance between the two points is called the Virial of the stress, and is reckoned positive when the stress is an attraction, and negative when it is a repulsion. The virial of a system is the sum of the virial of the stresses which exist in it.

If the system is subjected to the external stress of the pressure of the sides of a vessel in which it is contained, the amount of virial due to this external stress is three halves of the product of the pressure into the volume of the vessel.

The virial due to internal stresses must be added to this.

The theorem of Clausius may now be written—

$$\tfrac{1}{2}\Sigma(m\overline{v^2}) = \tfrac{3}{2}pV + \tfrac{1}{2}\Sigma\Sigma(Rr)$$

The left-hand member denotes the kinetic energy.

On the right hand, in the first term, p is the external pressure on unit of area, and V is the volume of the vessel.

The second term represents the virial arising from the action between every pair of particles, whether belonging to different molecules or to the same molecule. R is the attraction between the particles, and r is the distance between them. The double symbol of summation is used because every pair of points must be taken into account, those between which there is no stress contributing, of course, nothing to the virial.

As an example of the generality of this theorem, we may mention that in any framed structure consisting of struts and ties, the sum of the products of the pressure in each strut into its length, exceeds the sum of the products of the tension of each tie into its length, by the product of the weight of the whole structure into the height of its centre of gravity above the foundations. (See a paper on "Reciprocal Figures, &c." Trans. R. S. Edin., vol. xxvi. p. 14. 1870.)

In gases the virial is very small compared with the kinetic energy. Hence, if the kinetic energy is constant, the product of the pressure and the volume remains constant. This is the case for a gas at constant temperature. Hence we might be justified in conjecturing that the temperature of any one gas is determined by the kinetic energy of unit of mass.

The theory of the exchange of the energy of agitation from one body to another is one of the most difficult parts of molecular science. If it were fully understood, the physical theory of temperature would be perfect. At present we know the conditions of thermal equilibrium only in the case of gases in which encounters take place between only a pair of molecules at once. In this case the condition of thermal equilibrium is that the mean kinetic energy due to the agitation of the centre of mass of a molecule is the same, whatever be the mass of the molecule, the mean velocity being consequently less for the more massive molecules.

With respect to substances of more complicated constitution, we know, as yet, nothing of the physical condition on which their temperature depends, though the researches of Boltzmann on this subject are likely to result in some valuable discoveries.

M. Van der Waals seems, therefore, to be somewhat too hasty in assuming that the temperature of a substance is in every case measured by the energy of agitation of its individual molecules, though this is undoubtedly the case with substances in the gaseous state.

Assuming, however, for the present that the temperature is measured by the mean kinetic energy of a molecule, we obtain the means of determining the virial by observing the deviation of the product of the pressure and volume from the constant value given by Boyle's law.

It appears by Dr. Andrews' experiments that when the volume of carbonic acid is diminished, the temperature remaining constant, the product of the volume and pressure at first diminishes, the rate of diminution becoming more and more rapid as the density increases. Now, the virial depends on the number of pairs of molecules which are at a given instant acting on one another, and this number in unit of volume is proportional to the square of the density. Hence the part of the pressure depending on the virial increases as the square of the density, and since, in the case of carbonic acid, it diminishes the pressure, it must be of the positive sign, that is, it must arise from *attraction* between the molecules.

But if the volume is still further diminished, at a certain point liquefaction begins, and from this point till the gas is all liquefied no increase of pressure takes place. As soon, however, as the whole substance is in the liquid condition, any further diminution of volume produces a great rise of pressure, so that the product of pressure and volume increases rapidly. This indicates negative virial, and shows that the molecules are now acting on each other by *repulsion*.

This is what takes place in carbonic acid below the temperature of 30·92° C. Above that temperature there is first a positive and then a negative virial, but no sudden liquefaction.

Similar phenomena occur in all the liquefiable gases. In other gases we are able to trace the existence of attractive force at ordinary pressures, though the compression has not yet been carried so far as to show any repulsive force. In hydrogen the repulsive force seems to prevail even at ordinary pressures. This gas has never been liquefied, and it is probable that it never will be liquefied, as the attractive force is so weak.

We have thus evidence that the molecules of gases attract each other at a certain small distance, but when they are brought still nearer they repel each other. This is quite in accordance with Boscovich's theory of atoms as massive centres of force, the force being a function of the distance, and changing from attractive to repulsive, and back again several times, as the distance diminishes. If we suppose that when the force begins to be repulsive it increases very rapidly as the distance diminishes, so as to become enormous if the distance is less by a very small quantity than that at which the force first begins to be repulsive, the phenomena will be precisely the same as those of smooth elastic spheres.

M. Van der Waals makes his molecules elastic spheres, which, when not in contact, attract each other. His treatment of the "molecular pressure" arising from their attraction seems ingenious, and on the whole satisfactory, though he has not attempted a complete calculation of the attractive virial in terms of the law of force.

His treatment of the repulsive virial, however, shows a departure from the principles on which his investigation is founded. He considers the effect of the size of the molecules in diminishing the length of their "free paths," and he shows that this effect, in the case of very rare gases, is the same as if the volume of the space in which the molecules are free to move had been diminished by four times the sum of the volumes of the molecules themselves. He then substitutes for V, the volume of the vessel in Clausius' formula, this volume diminished by four times the molecular volume, and thus obtains the equation—

$$\left(p + \frac{a}{V^2}\right)(V - b) = R(1 + at),$$

where p is the externally applied pressure, $\frac{a}{V^2}$ is the molecular pressure arising from attraction between the molecules, which varies as the square of the density, or inversely as the square of the volume. The first factor is thus what he considers the total effective pressure. V is the volume of the vessel, and b is four times the volume of the molecules. The second factor is therefore the "effective volume" within which the molecules are free to move.

The right hand member expresses the kinetic energy, represented by the absolute temperature, multiplied by a quantity, R, constant for each gas.

The results obtained by M. Van der Waals by a comparison of this equation with the determinations of Regnault and Andrews are very striking, and would almost persuade us that the equation represents the true state of the case. But though this agreement would be strong evidence in favour of the accuracy of an empirical formula devised to represent the experimental results, the equation of M. Van der Waals, professing as it does to be derived from the dynamical theory, must be subjected to a much more severe criticism.

It appears to me that the equation does not agree with the theorem of Clausius on which it is founded.

In that theorem p is the pressure of the sides of the vessel, and V is the volume of the vessel. Neither of these quantities is subject to correction.

The assumption that the kinetic energy is determined by the temperature is true for perfect gases, and we have no evidence that any other law holds for gases, even near their liquefying point.

The only source of deviation from Boyle's law is therefore to be looked for in the term $\frac{1}{2}\Sigma\Sigma(Rr)$, which expresses the virial. The effect of the repulsion of the molecules, causing them to act like elastic spheres, is therefore to be found by calculating the virial of this repulsion.

Neglecting the effect of attraction, I find that the effect of the impulsive repulsion reduces the equation of Clausius to the form—

$$pV = \frac{1}{3}\Sigma(m\overline{v^2})\left\{1 - 2\log.\left(1 - 8\frac{\rho}{\sigma} + 17\frac{\rho^2}{\sigma^2} - \&c.\right)\right\}$$

where σ is the density of the molecules and ρ the mean density of the medium.

The form of this equation is quite different from that of M. Van der Waals, though it indicates the effect of the impulsive force in increasing the pressure. It takes no account of the attractive force, a full discussion of which would carry us into considerable difficulties.

At a constant temperature the effect of the attractive virial is to diminish the pressure by a quantity varying as the square of the density, as long as the encounters of the molecules are, on the whole, between two at a time, and not between three or more. The effect of the attraction in deflecting the paths of the molecules is to make the number of molecules which at any given instant are at distances between r and $r + dr$ of each other greater than the number in an equal volume at a greater distance in the proportion of the velocities corresponding to these distances. As the temperature rises, the volume being constant, the ratio of these velocities approaches to unity, so that the distribution of molecules according to distance becomes more uniform, and the virial is thus diminished.

If there is a virial arising from repulsive forces acting through a finite distance, a rise of temperature will increase the amount of this kind of virial.

Hence a rise of temperature at constant volume will produce a greater increase of pressure than that given by the law of Charles.

The isothermal lines at higher temperatures will exhibit less of the diminution of pressure due to attraction, and as the density increases will show more of the increase of pressure due to repulsion.

I must not, however, while taking exception to part of the work of M. Van der Waals, forget to add that to him alone are due the suggestions which led me to examine the theory of virial more carefully in order to explore the continuity of the liquid and the gaseous states.

I cannot now enter into the comparison of his theoretical results with the experiments of Andrews, but I would call attention to the able manner in which he expounds the theory of capillarity, and to the remarkable phenomenon of the surface tension of gases which he tells (p. 38) has been observed by Bosscha in tobacco smoke. As tobacco smoke is simply warm air with a slight excess of carbonic acid, carrying solid particles along with it, the change of properties at the surface of the cloud must be very slight compared with that at the surface where two really different gases first come together. If, therefore, the phenomenon observed by Bosscha is a true instance of surface-tension, we may expect to discover much more striking phenomena at the meeting-place of different gases, if we can make our observations before the surface of discontinuity has been obliterated by the inter-diffusion of the gases.

J. CLERK-MAXWELL

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

An Anagram

THE practice of enclosing discoveries in sealed packets and sending them to Academies, seems so inferior to the old one of

Huyghens, that the following is sent you for publication in the old conservated form :—

$A^8C^3DE^{15}F^4GH^6I^{10}L^3M^3N^8O^6P$
$R^4S^8T^{14}U^6V^3WXY^3$

WEST

"Manufactured Articles"

THERE are precedents to justify a hope that it would be no excursion beyond the province of NATURE, if somebody who knows that molecules possess the essential character of a manufactured article were kindly to explain how he knows a manufactured article when he sees it, in his mind's eye or elsewhere.

The answer used to be "contrivance, design; an end, a purpose; means for the end, adaptation to the purpose." Thus, it was said, we find in a watch; "we perceive that its several parts are framed and put together for a purpose." The same thing, it was further said, we find still more in the works of nature, "and that in a degree which exceeds all computation." And why so much more? Because "the contrivances of nature surpass the contrivances of art, in the complexity, subtlety, and curiosity of the mechanism; and still more, if possible, do they go beyond them in number and variety." This was the old answer: the new one is contained in such phrases as these: "exact equality," "exact unison," "exactly the same magnitude," "constants not approximately but absolutely identical."

Here it is hard not to stop and ask what can possibly prove that these things are absolutely so: or what can possibly contribute the smallest probability to a hypothesis that anything is absolutely anything, I do not say among the laws of nature, but among its collocations. Very likely it might be proved that the mean-square variation in the value of one of the above-mentioned constants is a prodigiously smaller fraction of its mean value than any other fraction which the molecular theory has occasion to take account of; and anyhow the fact remains that a molecule of bismuth, for instance, differs from a molecule of lead immensely more than two molecules of either can differ from one another. Perhaps this will do as well for the argument; if so, there is no excuse for the absolute; and whether or no, the argument will be the better for explanation, or perhaps it will be the worse for the argument.

However this may be, the difference between the old answer and the new one is rather instructive. An eager disputant might say the new one was contradictory of the old one; but it is safer to say that the new is at best independent of the old. Clearly a watch is about the last thing which would be cited to illustrate the new sort of manufactured article. The examples which our authors do by preference cite are coins, weights, and measures; and certainly it would be difficult to name manufactured articles which should better exemplify uniformity for the sake of uniformity. And for a very good reason (that is the worst of it); because the purposes of coins, weights, and measures are defeated, they who handle them deceived, and (as our authors are careful to say) they who manufacture them deceivers, so far as the things are not uniform. So the inference from such things only comes to this, that uniformity is a character of manufactured articles when uniformity is part of the purpose of manufacture. Is then the new argument, after all, a special case of the old one? Not so: for when men produce as a novelty a special case of an old argument, this must be because it is an especially strong case of the same; but we have seen that the old argument owes much of its virtue to complexity and variety; therefore, our modern manufactured articles, which are above all things simple and uniform, will only furnish a special case of the old argument by furnishing an especially weak one. Design, in short, has nothing to do with the new argument, and we must look for analogies among manufactured articles which are uniform, not because uniformity adapts them to their purpose, but simply because they *are* manufactured articles.

The nearest approach I can think of is to be found on a scale almost molecular, for number and sometimes for magnitude, in a London wilderness of similar and similarly situated houses. It is oppressive to walk past these boxes so nearly identical in form, and to think of the infinite variety of their contents; to think how different they would have been, and how much fitter for their purposes, if their inhabitants could have secreted them as a snail secretes his shell. And why does it make all the difference that they have been manufactured? Why did not the manufacturer vary them according to the interests connected with them? Of course because he did not care about those interests; because he could not foresee them; and because it would not answer to try and provide for them. And now we understand the sort of manufacturer the new argument reveals: a manufacturer who does not care what becomes of his articles the moment he gets them off his hands by his formulas beginning to be interpretable; a manufacturer who cannot solve his own equations except in a grossly approximative fashion; a manufacturer who could not give his constants the proper values if he knew what values to give them.

Uniformity, in short, is not as such the sign of a manufactured article, except as it may be the sign of an imperfect manufacturer. I do not suppose this is what the new argument is meant to mean: but this, I submit, is what it does mean. Perhaps, however, some competent supporter of it will kindly explain it a little.

C. J. MONRO

Yorkshire College of Science

WILL you permit a few words upon your allusion to this College in a leading article of the 8th inst.?

If its promoters have confined their present efforts to the establishment of a Faculty of Science, one cause has been that the amount of their funds compelled a selection instead of a comprehension of subjects. With a capital of 26,000*l*. they could not venture to cover so large a field as Owens College commenced upon with an invested endowment of four times the amount. But already, before our doors are opened, we have cheering signs that in providing a function to which endowments may be entrusted, the College will accrete to itself aid from widely-divergent quarters. The Royal assent has been given to an amended scheme of the Endowed Schools Commissioners for the Akroyd Charity, by which an important annual residue is allotted to the College, with representation upon the Trust. By the liberality of the Clothworkers' Company, the sum of 500*l*. per annum is set apart for three years for a Professor of Textile Industries and for Scholarships. Is it unreasonable to hope that new professorships will be established by the generosity of private individuals? The existence here of a flourishing School of Medicine is favourable to your views of massing the Faculties, and already a first link of union is being forged between the two bodies in relation to the classes in Chemistry.

Do not suppose that the College adopts *Pannus mihi panis* as its motto. A thoroughly practical community must run a risk of magnifying the *practice* of science rather than its *theory*, but if the selection of professors has been fortunate, there is no doubt that students will be taught practice through theory. Your forcible remarks will doubtless strengthen the hands of certain liberal donors to the College, who have offered increased sums when an Arts Faculty can be established.

Leeds, Oct. 12

R. REYNOLDS

On the Process of Tone-making in Organ-pipes

THE natural order of harmonic progression in an open organ-pipe is well known. That there is from the same pipe an inverse order of harmonics equally natural is not equally well known. There is no intimation that I am aware of, in any treatise on sound, of this fact having been observed, and the absence of recognition is no doubt attributable to a general disregard of the study of the comparative acoustics of musical instruments. My investigations into the process of tone-making in organ-pipes and other instruments have clearly shown me that there is *an order of transitive* harmonics distinct from the *order of concomitant* harmonics or "over-tones." Why I call them "transitive" will be apparent in the argument. Certain it is that our mimaphonic power in organ-pipes and in other musical devices depends on the command we can ensure over these two orders distinctively, and also on their comparative influences on the tones produced. In this manifestation of an inversion of harmonic progression, the nature, and, without extravagance one may say, the individuality, of the aëroplastic reed is most fully pronounced. Experimental proof is easily obtained, and, whilst bringing into prominence the peculiar display, will at the same time furnish indubitable evidence of the formative power exercised by the air-reed in the process of tone-making.

By the term "tone-making" is to be understood the manner of origination not merely of a note of defined pitch emitted by a musical instrument, but also of all the constituent sounds which give colour or quality to the note, and enter into the effect perceived by the ear. The artist, according to his sagacity, seizes on the faintest hints of nature, and with more or less consciousness of insight into law is able to control the process.

The modern theory of musical quality, or *timbre*, for which we are indebted primarily to Johannes Müller, and subsequently to Helmholtz, who by elaborate investigation has made the subject specially his own, takes account only of the varying intensities of the harmonics present in the compound tone, classed in two series, the "open" and the "stopped," or otherwise the "even" and "uneven," in regular progression. To the system of associated sounds in harmony the present inquiry has no reference; my purpose is to press the claim for recognition of another series in addition to these, to show that quality, and especially mimaphonic quality, in sounds, in whatever degree attributable to harmonics combined with the fundamental, is no less dependent for its character on the "order" in which harmonics come on or develop themselves in the growth of the tone. In plants there is a direct order of appearance—leaves, then flowers; a reversed order is as natural, and flowers come before leaves.

If an "open diapason" pipe of small scale is taken, and some slight variation made in the voicing, the pipe may be converted into a "flute harmonique," and it will give a note an octave higher than before; that is to say, the fundamental is abolished, and the octave or first harmonic reigns in its stead. The pipe will probably be now "unsteady," frequently attempting to reinstate the fundamental. This tendency we may counteract by drilling a small pin-hole at the side of the pipe, and the trifling amount of external air thereby admitted will destroy the tendency, by preventing the perfect formation of the node required by the fundamental. The perforation should be made at the true point of localisation of the node, which (as explained in a former letter in NATURE, vol. ix., p. 301) is at about [illegible] of the whole length of pipe reckoned from the level of the mouth. If we next enlarge the hole at the foot of the pipe, thus allowing greater force to the wind-current, and if we have properly manipulated the pipe, we shall on the trial of its sound hear the twelfth coming on as the forerunner of the octave, most distinctly and with a perceptible interval between the appearance of the twelfth and octave. The effect is more certain if the mouth is cut to a height less than that marked by scale, which would be ¼ of the width of mouth; and if, further, the pipe is slightly coned—a provision favouring the harmonic. By other changes of treatment, the fifteenth or double octave may be brought out as the introductory harmonic, and the twelfth following, and if we will we may restore the original ground-tone. The "flute harmonique" in this style is to be chosen for this experiment, not as representative of quality, but that in this overstrained condition it clearly defines the entrance of each harmonic, the order of succession, and the interval between each. In other varieties of pipe the "quality" is characterised by these harmonics, and in this order, but so blended as it were in a "portamento" glide that even critical ears fail to detect the elements combined into the effect. It is, so to speak, "an excess" of nature, which is often necessary to open our eyes to the perception of her commonest realities.

A diapason pipe is never so strong and brilliant in character as when it is just verging on the transmutation of fundamental to octave; for good vigorous quality, therefore, it is restrained only to just within the limit; nevertheless the presence of the octave-harmonic as the precursor of the fundamental should always be felt with its jubilant energy, then afterwards, the fundamental taking full possession of the pipe, producing its own octave-harmonic with almost equal exuberance of power. The precursory harmonic is of the transitive order. We have to recognise two distinct series of open harmonics—the direct order, *over-tones of the pipe*, which are derivatives of the fundamental, and the inverse order, the tones of which may be called *stem-tones of the reed*, for they are thrown off by the reed in swift succession, and declare the non-isochronous nature of the air-reed's motion. There is nothing erratic about these stemnal harmonics or the order of their appearance; they are due to the untamed vigour of the reed, and have this distinguishing law—they are transitive, each one dies in giving birth to the next, whereas the over-tones of the pipe coexist with the fundamental, and are the direct consequence of the excess of excitation in the air-column of the pipe (see more at length in NATURE, vol. viii., p. 383), providing a safety-valve for the permanence of pitch in the ground-tone, by employing the surplus energy acquired from the reed's vivacity in new forms of growth.

Whenever from an organ-pipe we hear harmonics together with the fundamental, then the air-reed is vibrating to its fullest amplitude, for it is the superabundant vitality of the air-column that sustains the coexistent ones; but when we hear harmonics independent of the fundamental, then we may be sure that they are the expression of the higher activity of the reed itself, then working with lessened *amplitude* of motion, yet with greater *velocity* of vibration.

The genesis of these tones is due to the association of reed and pipe. Without the pipe the reed could not produce tone, would be barren as one sex. As the pipe is silent and requires some external impulses to bring it into life, so the air-reed needs something to act upon before it can vibrate or swerve from its course in minute degree; some inequality of environment is all it asks—some alliance with power distinct from its own. Take away the pipe, leave it only the mouth, and it will pull against that and begin to work according to its nature, and even in that rudimentary condition will elicit tone of definite pitch.

Many classes of organ-pipes give harmonics of the direct order without a trace of those of the inverse order; on the other hand, the several varieties of pipes which give the inverse order invariably yield the direct order subsequently with the ground tone; and why? It will be comprehended at once, if I have rendered my meaning clearly, that the initial harmonics proclaim the intense vigour of the reed, and that force, unabated in strength, although widened in scope, is transferred to the air-column of the pipes The difference of effects produced by the two orders constitute. that variety of quality which distinguishes string-tone from horn-tone, and a further modification chiefly in relative times of sequence asserts its peculiarity as reed-tone; yet, again, there are in both series departures from truth of pitch, in some qualities an over-flatness of one or more harmonics, and in some an over-sharpness. The blast of the trumpet combines both flat and sharp harmonics strongly. The *direct* order of harmonics may be likened to an ascending arpeggio coalescing into a chord—the *transitive* to a descending arpeggio, in some instances having intervals regularly defined, in others starting abruptly and with wayward intensity, and in other displays passing swiftly onward to the fulness of tone, imperceptibly blended as is the "portamento" glide of voice or string.

In all the "Geigens" and "Gambas" and similar organ-pipes mimaphonic of "stringy quality," the transitive harmonics are the true cause of their speciality. Numerous experiments prove this to the eye as well as to the ear. I shall be able to show that the "Gambas" are characterised also by an over-sharpness of these transitive harmonics, and this paper is a necessary introduction to my proposed examination of the mode in which the peculiar quality of tone is built up in this attractive class of pipes.

HERMANN SMITH

Can Land-Crabs Live under Water?

PERMIT me to inform Mr. J. C. Galton that the authority for my statement in the "Outlines of Physiology" is also derived from "some book or other;" and that this "turns out" to be the classical "Hist. Nat. des Crustacés" of Milne-Edwards, vol. ii. pp. 16, 18, with which perhaps your correspondent is unacquainted.

Milne-Edwards, in his turn, refers (p. 19) to those who have studied the land-crabs in the Antilles and on the South American coast, viz., Rochefort, Feuillée, Labat, and Brown. He elsewhere, also, treats the subject as a comparative anatomist and physiologist (Ann. des Sciences Nat.; Todd's "Cyclopædia").

Whether the land-crabs of the east differ in their habits from those of the west is of course open to inquiry; and also in what ways (either anatomically or physiologically) they differ; but the question is clearly not whether they can survive for a few hours under water, but whether practically they can live in that element or are at last asphyxiated in it.

10, Savile Row, Oct. 6 JOHN MARSHALL

Bright Meteors

AT 8.55 this evening a party of six observed a meteor in the constellation Aries, or below it, which emitted light sufficient to cast a bright gleam on the neighbouring trees. The body of the meteor shot rapidly along a course extending about 20°. It then seemed to explode suddenly, and its track was luminous for a short time. The granular *débris* of the meteor continued to pursue, with very much retarded velocity a path slightly deflected from its former course: it continued to do so for several degrees and it was, I think, fully a minute after the explosion that several of us almost simultaneously exclaimed, "It is falling." It resembled the expiring light of one globe of a rocket charged with golden rain. The falling motion was very slow. I think it was visible for two minutes after the explosion, but though we tried more than once to consult our watches, the light was insufficient. HENRY H. HIGGINS

Rainhill, Oct. 11

AN exceedingly brilliant meteor was seen here about 8.50 on Sunday evening, which was so bright that it attracted general attention, the light from it being as strong as an unusually bright flash of lightning, but more white. On looking up I saw, near the zenith, a long almost straight and uninterrupted ribbon of light, somewhat pointed at the end towards the north-east. After watching it for some time and noticing that it retained its brilliancy, I began slowly counting, and counted up to twenty before there was any noticeable diminution of luminosity. The last portion visible was the end opposite the pointed end, which appeared as a faintly luminous patch as large as the apparent disc of the moon. I consider that, from its first appearance, it was visible from 80 to 100 seconds.

Wisbech, Oct. 11 A. BALDING

Rainbows

As a supplement to the description of a "Double Rainbow," published by Prof. Tait in NATURE, vol. x. p. 437, the following diagram may be of interest to your readers. It represents a phenomenon which was seen here a few days ago, and one which I should think must be of very rare occurrence.

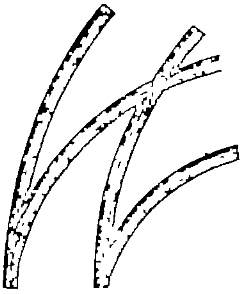


FIG. 1.

It will be observed that all the four bows were incomplete, but this only arose from the accidental cause mentioned by Prof. Tait. The two extra bows were due to reflection from a calm sea.

It may perhaps be remembered that about eighteen months ago I published in NATURE a verbal description of a rainbow similar to that now figured by Prof. Tait; only I was fortunate enough to see the bows complete and extraordinarily brilliant. Hence there were three bows, thus :—

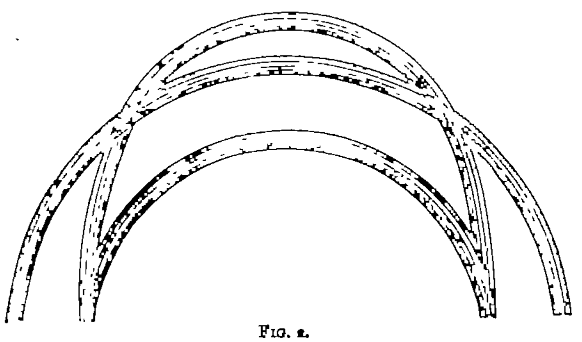


FIG. 2.

I presume that the presence of the fourth bow, as shown in the first diagram, is to be accounted for by the reflection from the sea having been sufficiently bright to give rise to a double concentric bow. GEORGE J. ROMANES

Dunskaith, Ross-shire, Oct. 3

IN reference to Mr. Tait's letter in NATURE, vol. x. p. 460, it may interest some of your readers to hear that our party saw a very perfect lunar rainbow at North Malvern, Worcestershire, on the evening of July 27, this year. The bow was so perfect that the colours were easily distinguishable—that is, of course, the main colours. The appearance lasted about five or ten minutes (10.35 to 10.45 P.M.) JOHN LATCHMORE, JUN.

Leicester, Oct. 12

The Cry of the Frog

WITH reference to the power of the frog to cry out, I may mention that while in India, as I was walking in my garden after dusk during the rainy season, when a peculiar kind of enormous green frog make their appearance for a few weeks, I was surprised to hear a cry exceedingly like that of a baby. On sending for a light I found a large frog, with a small one in its throat which it was apparently swallowing, while the small frog, the snout of which was just perceptible, was shrieking in the way I describe. On tapping the big frog sharply on the back, the little frog jumped out and made off.

Leamington, Oct. 10 J. P. G.

I HAVE on three different occasions heard a frog expostulate in the manner described by Mr. Mott. One did so on being patted inquisitively by a cat; the two others on being examined by a little dog. In each case the frog was of so unusually vivid a yellow as to suggest that it was either a variety of the common frog, or that it was in some unusual condition. Is Mr. Mott's frog equally brilliant? I may add that my three were also Leicestershire frogs. E. H.

Oct. 13

IT may interest your correspondent who has elicited what he believes to be a cry of fear from a frog, to know that an explanation of this cry—which is probably but the croaking experiment or *Quackversuch* of Goltz—is given at p. 201 of the recently issued volume of the West Riding Asylum Reports in the very remarkable paper by Dr. Lauder Brunton, on "Inhibition, Peripheral and Central." The extract is too long for quotation. H. W. P.

Oct. 13

I REMEMBER as a boy being rather startled by a shrill wailing cry which proceeded from a small pond, and on running to the spot I found a common snake in the act of swallowing a frog. They were on the surface of the water in the middle of the pool; the hinder part of the frog had already disappeared, and the terrified creature was crying piteously. He proved, however, too big a mouthful to be readily disposed of, and when by the aid of a long stick I interrupted the banquet and released him, he dived away apparently unhurt.

Though I have lived much in the country, I never heard a frog cry but on this occasion. I have often seen them played with, tumbled about, and patted by dogs and cats, as described by your correspondent F. T. Mott, but they have always borne the indignity in silence. F. BADEN BENGER

Manchester, Oct. 10

The Edible Frog

IT is stated in Bell's "History of British Reptiles," 2nd edit., p. 111, that the Edible Frog (*Rana esculenta*) was captured for the first time in this country in Foulmire Fen, Cambridgeshire, in 1843. Mr. Bell received some specimens which on comparison he identified as belonging to the continental species, he having at that time some living ones obtained from France. Mr. Bond, who had written to the *Zoologist* on this subject, said "the whole fen was quite in a charm with their song." Their very remarkable and sonorous croak had procured for these frogs the name of "Cambridgeshire nightingales."

I have recently been informed that this reptile was introduced from France some fifty years ago, and turned loose in the south of Cambridgeshire; and that very recently some one who is partial to the dish called "Frog-pie" has introduced the animal into Norfolk. But I cannot obtain any satisfactory information as to the naturalisation of the reptile. Are those *brought* into this country dying out? If not, they do not seem to have reached Norfolk, and I cannot find any in this neighbourhood. Is, then the *Rana esculenta* to be regarded as a British reptile? If any of the readers of NATURE can inform me whether they have obtained it in the Fen district, I should be much obliged.

Wisbech, Oct. 9 SAML. H. MILLER

SOUNDINGS AND CURRENTS IN THE NORTH PACIFIC OCEAN

PREVIOUS accounts of the soundings of the U.S. steamer *Tuscarora* in the North Pacific Ocean, with reference to laying a cable between America and Japan, have described the work accomplished sailing from the Asiatic coast up to lat. 41° 09′ N., long. 144° 01′ E., after two projected routes had been tried and abandoned. From that point the *Tuscarora* went to Hakodadi to obtain a supply of coal, and thence sailed to lat. 46° 38′ N., long. 151° 47′ E., from which point soundings were taken on a backward line to the position which was left to go to Hakodadi; the backward line skirting the shores of the Kurile Islands. All the soundings are taken at intervals of 29 or 30 miles. Upon the new route thus surveyed from Yokohama, for a distance of 1,000 miles, the depths range from 300 to 2,270 fathoms, the greatest declivity being 161 ft. to the mile, between lat. 40° 10′ N., long. 142° 57′ E., and lat. 41° 09′ N., long. 144° 01′ E. The depth gradually increased between lat. 47° 44′ N., long. 154° 15′ E. and lat. 50° 19′ N., long. 159° 39′ E. (a distance of 260 miles), at the rate of about 60 ft. to the mile; the depth at the point last named being 3,754 fathoms. The course thence was through open water between the Kamschatkan coast and the Aleutian Islands; but just before entering the latter group the steepest declivity was found that has been met with during this survey. The preceding and succeeding coasts, each at a distance of 29 miles, gave depths of 2,460 fathoms, while this one, in lat. 52° 06′ N., long. 171° 15′ E., gave 4,037 fathoms, a slope of at least 326 ft. to the mile. Thence to lat. 51° 58′ N., long. 174° 31′ E. (about three miles from Atchka Island), the water shoaled to 332 fathoms, rising at the rate of 187 ft. to a mile. From the last-named position to Tanaga Island the depths ranged from 200 to 1,800 fathoms, including only one remarkable declivity, which was between lat. 51° 08′ N., long. 178° 35′ W., and lat. 51° 28′ N., long. 177° 57′ W., where the slope was 250 ft. to the mile.

Between Tanaga Island and Illiouk, a distance of about 500 miles, the depths nowhere exceeded 1,500 fathoms. The latter place will afford facilities as an intermediate station for the projected cable. Thence the course surveyed was to the north-east, afterward veering to the eastward through Ounimak Pass, toward the locality at which the survey proceeding from Cape Flattery westward left off last autumn, lat. 53° 58′ N., long. 153° W. From Illiouk to lat. 54° 10′ N., long. 162° 39′ W., the depths were small, being at the latter point 44 fathoms. Thence to lat. 54° N., long. 158° 22′ W., a distance of 151 miles, there was a descent of 130 ft. to the mile, the depth at the last-named being 3,359 fathoms. From this point the bed rises, reaching about the same level as that of last autumn's stopping-place—2,520 to 2,530 fathoms—when within 30 miles of that location. The great depth of 3,359 fathoms can be avoided by selecting a line some 30 miles to the northward, where only 2,900 fathoms' depth is found. A series of observations south of the line already surveyed gave greater depths.

Numerous observations were made on currents and temperatures. Along the shores of Kamschatka and the Kurile Islands, in lat. 51° 39′ N., there is a counter-current setting to the south-west, extending to long. 164° E., with a surface temperature of 42° F. Thence to long. 174° E. in the same latitude, with a surface temperature of 46° to 47° F., is the Kamschatka current (a branch of the Japan stream, setting through Behring Straits), which is here about 350 miles in width. It lost 22° F. between the Japan coast and lat. 51° 39′ N. The counter-current within the same limits gained 6° F. The atmosphere lost 18° F. From long. 174° E., proceeding eastward, the cold Behring Straits current with about 42° surface temperature was found, having for its western limits St. Lawrence and St. Matthew Islands. It is inferred that the counter-current of long. 164° is part of the Behring Strait current, having the same temperature, and that it flows beneath the Kamschatka current; and this belief was confirmed by finding at 30 fathoms' depth and below the latter current one setting to the south-west. On this

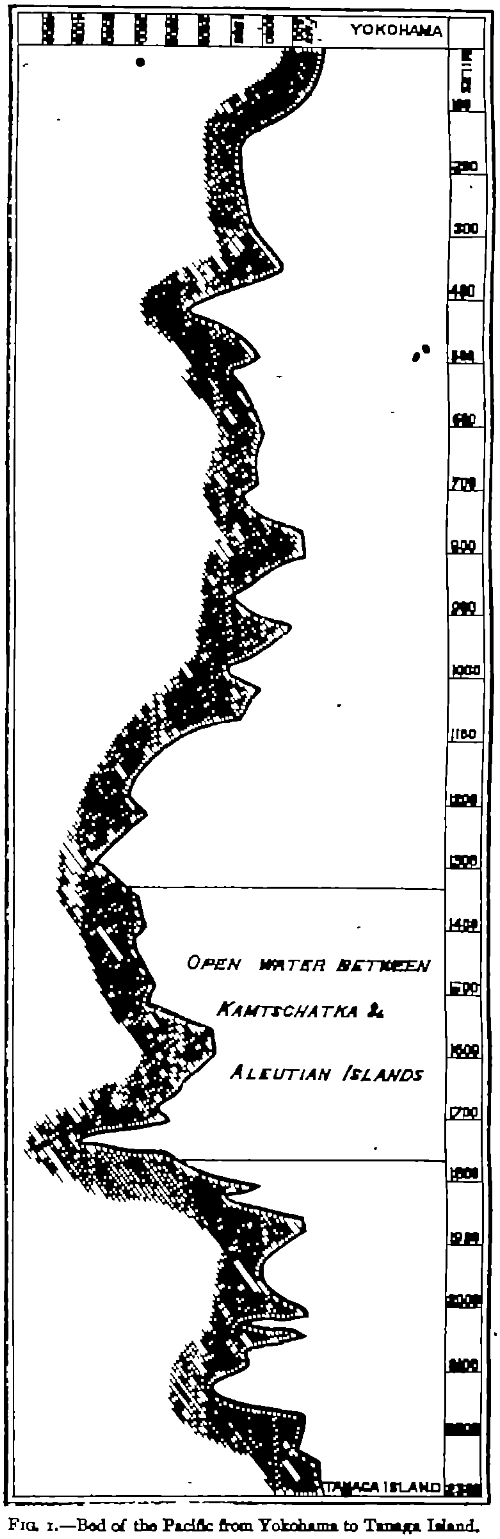


FIG. 1.—Bed of the Pacific from Yokohama to Tanaga Island.

theory the excess of loss of heat on the part of the Kamschatka current* over that of the atmosphere, as stated above, may be explained by attributing it to the cooling effect of the counter-current beneath. It may here be mentioned that the northernmost limit of the Japan stream was 51° 12′ N., long. 178° 20′ E.

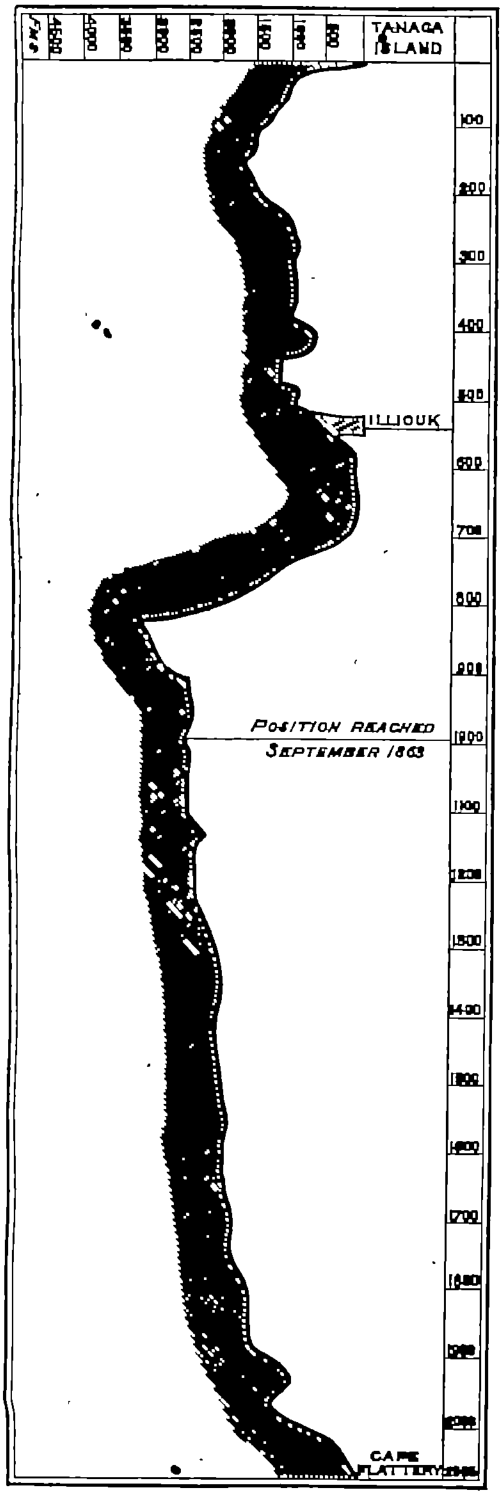


Fig. [illegible]—Bed of the Pacific, Tanaga Island to Cape Flattery.

The coincidence of observations on temperatures and currents was very noteworthy. There was found, for instance, at lat. 42° 51′ N., long. 148° 14′ E., a north-east surface current of a half-knot per hour; at 5 to 15 fathoms' depth the temperature was 40·3° F., and in this space the current was marked. In the next 5 fathoms the thermometer fell 6°, and correspondingly the current ceased to be observable at this 20 fathoms' depth. At 200 fathoms a steadily increasing current to the south-west was observed; while from 20 fathoms' depth all the way to the bottom—upward of 4,000 fathoms—the fall of temperature was only 1°. A cold stratum of water was discovered, coming down from Behring Straits as an under-current. Between lats. 51° and 52° and longs. 159° and 169°, this current is at 150 ft. below the surface, and itself of 400 ft. depth. It was perceptible at lat. 42° 47′ N., long. 148° 23 E., but south of that it disappears: lat. 51° 22′ N., long. 162° 20′ E. is believed to be nearly its centre. Now, at the last-named location, at 22 fathoms, the thermometer marked 35·7°; at 75 fathoms, 32°; at 100 fathoms, 35·5°. This current was again satisfactorily defined at lat. 51° 43′ N., long. 165° 25′ E., and there the temperatures were, at 25 fathoms, 37·7°; at 60 fathoms, 34·7°; at 100 fathoms, 37·7°. The bottom temperatures vary from 32° to 33·9°.

Reviewing the results of the entire investigation in respect to currents, the following deductions may be summarised:—The Kuro Siwa or Japan current extends on an easterly course toward the American coast, its northern limit nearly reaching the southern shores of Vancouver Island; and it passes down to the southward in what has been incorrectly denominated the "California cold current." Beneath this an under-current sets to the north-west, and in lat. 50° reaches the surface, after which it sets northward along the shores of British America and the outstanding islands, thence gradually turns to the westward, its direction being affected by the outline of the coast, and exhibits at Sitka a strength of one knot per hour and a northward flow. In lat. 53° 30′ N., long. 157° W., the current, to a depth of 5 fathoms, set to the south-east, and this continued while observations were made during sailing to the south-east; but between that position and the line of the islands the current was to the south-west, and close to the islands to the westward. It is believed that a part of the water carried to the north-west by the under-current, returns in long. 157° to the northern portion of the Japan stream, and mingles with it, returning to the southward along the western shores of America, as part of the surface current; and that the part to the westward of long. 157° which sets toward the south-west, passes as an under-current beneath the Japan stream. A rapid fall in temperature—from 57° to 47° in a few miles—in the Ounimak Pass, shows that the north-west shores of the Aleutian Islands are washed by the cold Behring Straits current, which is somewhat modified in temperature by the inflow of part of the westerly current from the eastward of the islands.

Many observations were made which indicated the relation of prevailing winds to surface currents. The material obtained from the sea bottom off the Kurile Islands had, in addition to the usual ooze, greyish-black sand, gravel, and lumps of lava. Similar sand and gravel were found, and also sponge, in the neighbourhood of the Aleutian Islands. The northern route for a telegraph cable, as finally indicated by this survey, is 4,200 miles in length; the southern, about 6,000 miles. The former route will present great though probably not insuperable difficulties, such as that of the sudden declivity off the Aleutian Islands, the frequent fogs which made even the survey tedious, the embarrassments incident to a northern region, where there are few of the means provided on more civilised shores to meet the requirements of working parties and occasional repairs. The chief merits of the northern route are its comparative shortness and its propinquity to United States territory.

NATURAL HISTORY NOTES FROM SOUTH AFRICA

MR. J. P. MANSELL, of Brooklyn, near King William's Town, Kaffraria, has sent us the following notes, the results of his own observation in the district in which he dwells:—

In November 1869 I was looking for some louries in the Bedford forest. My gun was loaded with a very small charge of dust shot. A large troop of monkeys was disturbing my birds, and, annoyed with them, I fired among them at random. One fell on the branches of a bush, shrieking piteously. I ran up to put the poor thing out of its agony, when to my great surprise I saw the whole troop (about twenty) rushing down the trees and screaming savagely. They came so close to me that I had some trouble in killing the wounded one, as I was afraid they would attack me. Were monkeys substituted for toucans in the frontispiece to Mr. Bates's Travels, the scene would be almost identical.

A few days ago, while working in my garden, my attention was drawn to a part of the kloof by the angry screams of birds, indicating a snake. On approaching the spot where the birds were collected, I noticed several dashing at a low shrub. As I approached the dark underwood an Ahætulla, whose characters do not agree with any published description, rushed out. I struck it with a spade, and then, curious to see how the birds would act, I flung it half alive over a branch of a tree, still holding it by the tail.

There were a great many bush birds, but especially noticeable were *Turdus olivaceus* and a Campephaga.

The first-mentioned birds kept flying round in a wide circle, dashing with open wing and beak at the snake, and screaming with the utmost fury. With such violence did these birds dash at their enemy, that more than once the bird fell on the ground from the branch against which it struck. The birds continued attacking the snake for some minutes.

While at the Koonap in 1865 I saw the common *Juida phœnicoptera*, which had a nest in the trunk of an Euphorbia, screaming with fury, and attacking boldly a red mierkatje, which was endeavouring to plunder its nest.

We have heard so much of the mysteries of fascination, &c., that I think a comparison of the cases I have given, together with the well-known way in which birds pursue owls, cats, and cuckoos, shows that it is more fear than anger which gives the subtle snake an easy prey, than any mysterious mesmeric influence; and I believe the immunity of the mongoose from the poison is owing to its closely-pressed, tight, wiry hair.

The wattles of turkey-cocks are a decided disadvantage to them in a warm country like this. I have lost two from the flies laying their eggs in the wounds inflicted by rival birds.

Some four or five years ago, when in Fort Beaufort, a friend of mine amused me by bringing a stuffed leopard to a pet monkey he had. The monkey would scream with terror, shut its eyes, and hide away in my friend's coat. On touching it with the claws its terror was piteous. On removing the leopard it would slowly peep out, and on catching sight of it close its eyes tight.

I do not think it is generally known that baboons in Karoo districts, such as Richmond and Hopetown, destroy in dry seasons numbers of lambs. A farmer told me that they were more destructive than any other wild animal in the district.

There are likewise two varieties of the leopard called respectively Berg and Rivière Tiger, from frequenting mountains or rivers; and the baboons are said to vary according to their locality. It is said that baboons will kill a leopard. A friend of mine at the Koonap had a tame baboon which shouldered arms and wrapped itself in a sheepskin like a Kafir.

South African Birds which eat Butterflies.—As some doubt was thrown on this subject in your journal a year ago, I now give the result of a year's careful observation, and I have little doubt the number could be greatly increased. *Cypselus caffer* eats *Pieris hellica* and *Terias rahel*, also numerous small Heterocera.

Zosterops capensis eats Pieridæ and small moths. On April 30, 1871, I saw a pair trying to capture a butterfly, which very cleverly eluded them.

Motacilla capensis—Pieridæ and moths, but prefers flies and bees.

Anthus capensis—*Pieris hellica* and *P. charina*.

Oriolus capensis—*Pieris charina* and *P. gidica* or *P. severina*.

Tchitrea cristata—*Pieris agathina* and other Pieridæ, and, I think, other butterflies too, but am not certain.

Dicrurus musicus. I saw this bird dart at and capture last year so large and rapid a butterfly as *Philognoma varanes*; it also destroys Pieridæ.

Lanius collaris. I have seen this bird take butterflies, but do not know whether it is in sport or for food.

The above instances are from actual observation, made in some cases more than once.

Migrations of Insects and Plants.—I have especially remarked, since my attention was drawn to it, how few conspicuously coloured and hairy caterpillars are attacked by birds. Some of these conspicuous caterpillars, on being touched, eject a nauseous liquid in large quantities; this is especially the case with *Antheræa tyrrhea*, the larva of which every year strips my thorn trees (*Acacia horrida*) quite bare. The eggs are large, enclosed in a hard, bluish white shell, and fastened in large clusters at the end of branches. They appear to be never destroyed by animals.

The moth generally issues in abundance after the first heavy warm rains of September or October, and is seldom to be found after a week. This is also the case with several allied moths. Hundreds may then be seen like small bats, and the next morning the ground is often strewed with their fragments, as they appear to be highly attractive to nocturnal birds. The larva is often attacked by ichneumons, but still the quantity is unappreciably diminished, and hundreds may be seen travelling from tree to tree. They are more numerous in wet than dry seasons.

We have had this year some remarkable visitations of Pieridæ. In October, November, and December I have seen enormous swarms, principally composed of *Pieris charina*, *severina*, *gidica*, and *hellica*. The early part of the summer was very cool, but just before Christmas and at present the heat has been most oppressive. On December 24, I found the shady inside of the kloof alive with *Pieris agathina*, in all the varieties, as far as I could judge, principally males. This butterfly is usually abundant in September, but I had observed only a few specimens in the early summer.

I tried to make a calculation as to their numbers, and selected a damp spot where most of the insects had settled. I counted on a spot about three yards square about fifty; many were hidden by stones and leaves. They were about equally abundant in other parts of the kloof, and I think, therefore, that fifty would be a fair average. As the kloof is 500 yards long, or thereabouts, and in some parts thirty yards broad, I think the following calculation (allowing for the extra attractiveness of the moist spot observed), namely, twice the quantity, calculated at three yards broad, would give a quantity of 16,666 for the entire kloof. The kloof was full of birds chasing these insects, and two days later the number was greatly diminished.

As far as my observations go, I am led to believe that there are three kinds of migrations among butterflies. The principal relates, for the most part, to Pieridæ, such as *Pieris hellica*, *gidica*, *severina*, *mesentina*, and *Colias electra*. These butterflies seem to be attracted to cultivated ground, old kraals, or cleared forest. On all these spots vast numbers of weeds—many introduced plants—spring up, and appear to be particularly attractive to these insects. These migrations take place as often against as with the wind.

Papilio merope, *Philogroma varanes*, *Pieris eriphia*, *Pieris sochalia*, and *Terias rakel* appear to migrate in the direction of the wind, and there are one or two others which perhaps do so also, such as *Junonia pelasgis*. When resident at Bedford I never saw these butterflies in seasons of drought, but so soon as the southerly winds with rain became abundant a few stragglers might be met with.

P. gidica, *mesentina*, and *severina* likewise share in these southerly and northerly migrations.

Lastly, there are the sudden and almost inexplicable appearance and disappearance of certain species, such as *Callidryas rhadia*, *Diadema misippus*, &c., although I see Mr. Bowker mentions having seen vast swarms of the former in the Drakensberg taking a south-easterly course. During the last two years I have hardly seen a specimen of these two butterflies. The year before they were most abundant. I would here remark that I do not remember to have noticed in any entomological work, although the shapes of butterfly wings are accurately described, an account of their peculiar and finely graduated modes of flight.

Thus, in Pieridæ, *P. hellica* flies generally in open ground from flower to flower, but alternately rises and falls and shifts from side to side. *Terias rahel* has a similar flight, but slightly more direct; *Colias electra* a similar flight, but I think a trifle swifter.

Cypselus caffer, which preys on these, generally describes semicircles, flying backwards and forwards over the grass in the manner of a scythe working, and it is curious to see how artfully these butterflies, by a slightly higher or lower flight, escape their much swifter winged enemy.

The different varieties of *P. agathina* in like manner vary. The whiter specimens (♂) frequent more the open, and are a trifle swifter in their flight than the gamboge and ochreous varieties, or their ♀. The latter frequent wooded spots, and rise and fall through the foliage like dead leaves, and it is surprising to see how with sluggish movements a slight change of direction saves their lives. *P. gidica*, *mesentina*, *severina*, and *sochalia* in like manner vary among themselves in their varieties and in different localities.

I was particularly struck, when on a visit to Cradock in 1867, by the difference of size and colour and flight in *Mesentinas* in the Karoo from that of those in the Bedford Forest.

Papilio cenea, which my observations confirm as being the female of *merope*, as so admirably indicated by Mr. Trimen, changes its flight in a remarkable manner when quitting the forest for the open plain. In the forest its flight is remarkably weak, especially if contrasted with that of its mate; whereas over open plains it rapidly rises out of sight, and soars away like some bird of prey with scarce a flutter of the wing.

Junonia pelasgis, *archesia*, and *amestris* are in like manner very similar in their flight, but differ with the difference of the localities they frequent; *J. archesia* being intermediate between the forest-frequenting *J. pelasgis* and the plain-loving *J. amestris*. It is also remarkable that where *J. archesia* frequents the same spots as *J. pelasgis*, its markings approach that species; where it delights in open country, about Kaffraria, it is bluer, and slightly more like *J. amestris*.

Nymphalis xiphares.—The ♀ of this species is much weaker in its flight than the male, and its coloration, as is known, differs remarkably. Last year I captured it in company with *P. merope* and ♀ *P. echerioides*, and was much struck at the time by the similarity of colour and pattern, although its imitation is much coarser than that of the other two butterflies.

A long series of ♂ and ♀ *Meropes* shows a remarkable variation, hardly two specimens being alike, and in one ♂ a small oblong black spot closes the discoidal cell of the fore-wing.

On some occasions plants of different orders seem suddenly to increase and then almost disappear for a season or so. This is notably the case with some Compositæ.

As I mentioned in a letter to Mr. Darwin, two species of Gramineæ, *Tragus aliena* and *Briza geniculata*, appear to spring up in the course of locust swarms. I at first was rather sceptical on this subject, but by carefully watching the locusts and examining *sour veld*, where these grasses do not generally grow, I believe that the opinion of the farmer who first called my attention to it is correct.

Mr. Darwin, I believe, raised plants from locust dung which I sent him, but I am not aware to what species they belonged.*

JEFFRIES WYMAN, M.D.

IN the death, on the 4th ult., at Bethlehem, N.H., of Prof. Jeffries Wyman, American biological science has lost one of its most able comparative anatomists. Prof. Wyman was born on Aug. 11, 1814, at Chelmsford, Massachusetts, and had therefore just completed his sixtieth year. His father was a well-known physician. He graduated in Arts at Harvard University in 1833, whereupon he commenced his medical education, and took his degree in 1837, after which he for two years continued his studies in Paris. Returning to Boston he became for some time curator of the Lowell Institute, where he commenced his career as a teacher by delivering two courses of lectures on comparative anatomy and physiology, in which he first gave indications of the lucid and well-ordered expository powers which throughout his life made him so great a favourite with all hard-working students. In 1844 he became Professor of Anatomy and Physiology in the Medical School of Richmond, Virginia, in connection with the Hamden-Sidney College. In 1847 he succeeded Dr. Warren as Professor of Anatomy in Harvard University; at which time, from the materials brought from Africa by Dr. Savage, he had the earliest opportunity of describing that naturalist's new genus of anthropoid apes, the Gorilla (*Troglodytes gorilla*, Savage). This professorship he held till 1866, and it is to him that Cambridge, Mass., almost entirely owes the development of its excellent Museum of Comparative Anatomy.

Prof. Wyman had for many years been a sufferer from phthisis, which necessitated his removing to the warmer climate of Florida during the winter months, and the cessation of his lectures and practical work. When the Peabody Museum of American Archæology and Ethnology was established, the founder appointed Prof. Wyman one of his trustees, and the board committed the incipient museum to his charge and direction. The seventh annual report of this institution, just issued, was his last production. Most of his written contributions to science are contained in the Journal and Proceedings of the Boston Natural History Society, of which for many years he was the president; and in the "Smithsonian Contributions to Knowledge."

Prof. Wyman was a man of singular modesty and truthfulness. His bad health was always in the way of his will to work; and his desire of completely mastering whatever he undertook, together with a certain over-cautiousness, has limited the number of his works. It is not remembered that he ever had a controversy. In his death a gap has been caused which it will be difficult to fill.

---

* See 'Origin of Species," 6th ed., p. 327

LECTURES IN NATURAL SCIENCES AT CAMBRIDGE

THE following lectures in Natural Science will be given at Trinity, St. John's, Christ's, and Sidney Sussex Colleges, during Michaelmas Term 1874.

On Electricity and Magnetism.—By Mr. Trotter, Trinity College, in Lecture Room No. 11. (Mondays, Wednesdays, Fridays, at 11, commencing Friday, Oct. 16.) Students desiring to attend this course are requested to call upon Mr. Trotter at his rooms on or before Thursday, Oct. 15. Students of Colleges other than Trinity, St. John's, Christ's, and Sidney, can be admitted on payment of a fee of 1*l.* 1*s.*

On Elementary Organic Chemistry.—By Mr. Main, St. John's College. (Tuesdays, Thursdays, Saturdays, at 12, in St. John's College Laboratory, commencing Tuesday, Oct. 20.) Instruction in Practical Chemistry will also be given. Students desiring this instruction are requested to call upon Mr. Main on or before Monday, Oct. 19. For members of Trinity, St. John's, Christ's, and Sidney, the fee for the lectures in Chemistry is 10*s.* 6*d.*, and for instruction in Practical Chemistry 1*l.* 1*s.* per term; for others the fees are respectively 1*l.* 1*s.* and 2*l.* 2*s.* per term.

On Palæontology.—(The Protozoa and Cœlenterata.) By Mr. Bonney, St. John's College. (Tuesdays and Thursdays, at 9, commencing Thursday, Oct. 15.)

On Geology.—(For the Natural Sciences Tripos. Preliminary matter and Petrology.) By Mr. Bonney, St. John's College. (Mondays, Wednesdays, and Fridays, at 10, commencing Wednesday, Oct. 14.) A course on Physical Geology will be given in the Lent Term, and on Stratigraphical Geology in the Easter Term. Papers will be given to Questionists every Saturday at 11, but the first paper will be set on Wednesday, Oct. 14, at 11, when arrangements will be made for further instruction, should it be required. Students desiring to attend any of these courses are requested to call upon Mr. Bonney on or before Wednesday, Oct. 14. Students of other Colleges can be admitted to these lectures on payment of a fee of 1*l.* 1*s.* for the course. An Elementary Course will be given in the Lent and Easter Terms.

On Vegetable Morphology.—(For the Natural Sciences Tripos.) By Mr. Hicks, Sidney College. (Tuesdays, Thursdays, and Saturdays, at 11, in the Taylor Lecture Room, beginning on Tuesday, Nov. 3.) The lectures during this term will be on the Morphology of Phanerogamia. For members of the above Colleges the fee for this course is 1*l.* 1*s.*; for others 2*l.* 2*s.*

A Course of Practical Physiology and Histology.—By the Trinity Prælector in Physiology (Dr. Michael Foster) at the New Museums. Lectures on Tuesdays, Thursdays, and Saturdays, at 10, commencing Tuesday, Oct. 20. Fees for the Practical Class, 3*l.* 3*s.*; for the course of two terms, 5*l.* 5*s.* This course is intended for those who have gone through a course of Elementary Biology similar to that given last Easter Term.

Also a short course of lectures on the *Physiology of Nutrition*, on Wednesdays, at 10, commencing Oct. 21.

On the Comparative Anatomy of Invertebrata.—By Mr. Martin, Christ's College. (Mondays, Wednesdays, and Fridays, at 12, commencing Friday, Oct. 16.)

NOTES

AMONG the Fellowships at Trinity College, Cambridge, awarded on Saturday last, one was given for proficiency in Natural Science. Although thrown open to the whole University, it was gained by a member of Trinity College, Mr. Francis M. Balfour, B.A., the circumstances of whose election are worthy of notice. The Fellowships at Trinity College are awarded according to the results of an examination held specially for the purpose, and not as in other Colleges, according to the positions gained by the candidates in the University Examinations or Triposes. The Natural Science Fellowship was no exception to this custom: a special examination in Physics, Chemistry, and Biology, was held in order to test the proficiency of the candidates. But it had previously been announced that the examiners were prepared in estimating the proficiency of the candidates to take into consideration records of original work in the shape of published memoirs or unpublished dissertations, and to be guided by the value of these as well as by the ordinary examination answers. In other words, the authorities of Trinity College formally declared that they were prepared to bestow a Fellowship *as a reward for, and thus as an encouragement to, research.* Mr. Balfour's success in his candidature was, we understand, due to the value attached to the original memoirs, chiefly on embryological subjects, sent in by him, as well for their actual worth as for the future of which they gave promise. We congratulate him and the Natural Science School at Cambridge on the result. The deadening influence of the examination system at Cambridge, great as it is in mathematics, bears with fearful effect on all Natural Science studies. The cramming necessary for success in a competitive examination such as the Natural Science Tripos, renders original research for the time being impossible, and goes far to destroy all power for it in the future. Mr. Balfour had the courage to commence original work before he had taken his degree. In spite of warnings that he was endangering his position in the Tripos, he chose the better part, and spent in research the time he might have frittered away in cramming for an examination. Incidentally he has thereby won a Fellowship. We trust that his example will be followed by other students, and the example of Trinity College by other Colleges, so that henceforward on the one hand early research may be the rule at Cambridge instead of the exception, and on the other the injurious effects of the Fellowship system may be lessened as much as possible.

THE following changes are proposed to be made in the Council of the Mathematical Society for the ensuing session:—Dr. Hirst, F.R.S., the retiring president, will become a vice-president, and be succeeded by Prof. H. J. Stephen Smith, F.R.S. Mr. Spottiswoode, F.R.S., having served his term of office as vice-president, will become an ordinary member of the Council. The vacancies caused by the retirement of Prof. Henrici, F.R.S., and Mr. J. J. Walker, have been filled up by the selection of Mr. R. B. Hayward and Mr. W. D. Niven. The Society has nearly completed its tenth year, and has had as presidents De Morgan, Sylvester, Cayley, Spottiswoode, and Hirst. It would, we think, be difficult to find more fitting representatives of the mathematical ability of this country, should the day ever arrive, in this day of congresses, for holding an International Congress of Mathematicians. When the Society started into existence on Jan. 16, 1865, there were, we believe, not more than two similar societies in the world; now, each year adds to the ever-lengthening chain. It is a singular and sad coincidence that as the present president on his accession to the chair had to announce to the members the great loss the Society had sustained through the death of the lamented Dr. Clebsch, so, too, as he vacates his office will it be his last task to tell of the decease of Dr. Otto Hesse; though in this sad case mathematicians have to mourn the loss of a man full of years and honours. The Society is thus left without a representative of the great body of German mathematicians in its list of foreign members. The election of the new Council will take place on Nov. 12. The above-named changes are those suggested by the present Council, and will be submitted in the usual way to all the members of the Society for their approval.

ANOTHER College for Working Women is about to be opened. Its inaugural meeting is announced for Friday evening, at No. 5, Fitzroy Street, Fitzroy Square. The committee aims at enabling women who can spare a few evenings a week to obtain gradually a liberal education. The fees are very low, and the classes numerous. A library and a coffee and conversation room will, it is hoped, promote friendly intercourse amongst the members. Many have promised to teach or occasionally lecture, amongst whom we see the names of Mr. J. G. Fitch, Mr. Thos. Hughes, Q.C. (Principal of the Working Men's College), Mr. Litchfield, Prof. Seeley, Mr. George Macdonald, Miss Chessar, Miss Keary, and Dr. Morell.

IN connection with the *conversazione* held at the opening of Owens College, Manchester, there was an interesting loan collection brought together through the energy of Mr. W. B. Dawkins and Mr. R. D. Darbishire. A large series of plants of the coal measures was exhibited, with specimens of the nearest known living representatives systematically placed among them to convey an idea of the kind of vegetation from which coal was formed. Near these was a geological model of a boring for coal. A quaint set of stone mining tools from the abandoned workings of the Alderley Edge copper mines, and wooden and iron tools found in Derbyshire, were of especial interest. The local geology was well illustrated, and there was a fine collection of fossil bones which have been recently discovered in a fissure at Windy Knoll, near Castleton, by Mr. Pennington. A well-supported endeavour was made to illustrate the latest stage of vertebrate life in England as known by the remains found in bone caves and river deposits; and an extensive collection of mammoth, bear, lion, and other bones was the result. Near these were cases containing early implements fashioned by man. A Manchester paper says of these cases: they "include all the evidence as to the antiquity of man given by both river and cave, and we need little scientific assistance to find out that these constitute the most complete set of stone implements ever got together. To make their evidence clearer, illustrated and explanatory diagrams are placed near them. . . . The collection of neolithic flints is wonderfully complete. A case sent by Mr. John Evans carries us from the rough model to the same instrument more exquisitely finished and moulded."

THERE is hope for scientific education when a sporting correspondent of the *Field* discourses on it. The gentleman in question has recently visited the Mining Academy of Freiberg, which he thus describes:—"Students of every nationality are found here, and there is no doubt that if a man likes to work he can learn a great deal, as some of the most celebrated professors in Germany are teachers. The only requisite for a student entering the Academy is that he should know a little German. This rule is not very strictly observed, and anyone of ordinary intelligence ought to pick up the requisite amount in a month, or six weeks at the outside. There are different courses open to the option of the student, such as an assaying course, chemical course, surveying and mining course, &c. These are each charged separately for, the fees ranging from 3*l*. to 5*l*. each. The blow-pipe course, given by the famous Prof. Richter, is 6*l*. Foreign students are charged 5*l*. yearly extra; German students are exempt from this tax. Living in Freiberg is excessively cheap. The whole course lasts three years, but I imagine that a man would do far better by picking out a few particular lectures and finishing in eighteen months or two years. Now, after the course, what return has a man for his money? I unhesitatingly answer that a man who has worked hard for two years at Freiberg ought to be able to go anywhere in any mining district in the world and command his 500*l*. a year. So many people are troubled with questions as to what to do with their younger sons, that I am sure that sending them to Freiberg, and giving them a first-class profession in two years for 375*l*. or 400*l*., is well worth their consideration. To such a man, *i.e.*, one well educated at Freiberg, the whole of the American continent, and, indeed, most of the world is open. Now that England is so 'blocked' it has become a necessity to go further afield, and probably mining engineering and assaying offer about the very best openings to an enterprising man. Immense deposits of metal are daily being discovered in Colorado and the south-western States, while Chili and Peru are short-handed." The sporting correspondent is correct as far as he goes, and it is perfectly true that many young Englishmen have gone to Freiberg, but he does not seem to know that the British Government has just fitted up a small cellar in Jermyn Street, and that with such a national metallurgical laboratory as this, of which of course the country should be justly proud, there is no fear that more young Englishmen will seek to perfect their studies in a foreign land.

FROM a paper on "Some Indigenous Tuscan Remedies," read by Mr. H. Groves before the recent Pharmaceutical Conference, it would seem that plants furnish a considerable portion of the medicinal products in use in that country. Many of the plants enumerated are well known as medicinal plants in other parts of Europe. The Chamomile (*Matricaria chamomilla*), for instance, is said to be found in the cupboard of every housewife, being used as a calming antispasmodic, and also applied hot externally for relieving pain. A custom very prevalent in Tuscany seems to be the administration of herb-juice in spring, which is prepared daily by many herbalists, and is also ordered by medical men. *Nasturtium officinale*, known as Crescione, is used in conjunction with *Cochlearia officinalis* in the composition of herb-juice. This latter plant, though indigenous, is also cultivated to some extent. The flowers of the Wallflower (*Cheiranthus cheiri*), under the name of *Viole gialle*, or Yellow Violets, are boiled in olive oil and used for enemata. With regard to products other than plants, the writer remarks that viper-broth is gone out of fashion, and the pharmacist is spared keeping those reptiles and the pincers with which they were handled. Snail poultices are still used in the country. The snails are applied alive, the shell being crushed or partly removed, and the snails set upside down on a piece of coarse paper; they are then sprinkled with a little vinegar and applied at once to the soles of the feet, on which they produce an irritation greater than mustard, and which is supposed to be efficacious in some cases of fever.

THE British Association partook this year somewhat of the nature of a Church Congress; the real Church Congress has, *en revanche*, partaken somewhat of a British Association meeting, Prof. Pritchard having communicated a paper to it giving his view of certain conclusions to be drawn from our present knowledge of molecules, and quoting in support of it the honoured names of Herschel and Clerk-Maxwell. As we are informed that the paper will be published *in extenso* elsewhere, we need not refer to it at any length here; but there is one bit of it which, coming from a clergyman and a professor at Oxford, we cannot refrain from quoting. He suggests that it would be a good thing "if in the study of every manse throughout England there were found a well-used microscope, and on the lawn a tolerable telescope; and, best of all, if those who possess influence in our national universities could see their way to the enforcement of a small modicum of the practical knowledge of common things on the minds of those who are to go forth and do battle with the ignorance and failings of our population, and to spread light throughout the land. A little knowledge of the ancient elements, fire, air, earth, and water, would save many a young clergyman from the vanity of ridiculous extremes, and from the surprise of the more wisely and widely educated among his flock." Surely no one will think that with regard to the Universities Prof. Pritchard is asking too much! He then goes on: "Depend upon it, whatever may be our suspicions or our fears, the pursuit of the knowledge of the works of nature will increase, and increase with an accelerated velocity; and if our clergy decline to keep pace with it, and to direct it into wholesome channels, they and their flocks will be overtaken, though from opposite directions, by the inevitable Nemesis of disproportion."

A SEVENTH edition of "The London Catalogue of British Plants" has just been issued. The chief differences between this and the preceding edition is in a renumbering of the specific names, and in those changes of technical arrangement which have now rendered it necessary to abandon the original series of numbers. The first edition of 1844 was closely adapted to the "British Flora" of the late Sir Wm. Hooker. This seventh edition is made to correspond with the "English Botany" of Dr. Boswell-Syme, third edition, as far as to the grasses. For the ferns and allied orders, the arrangement and nomenclature of Dr. Hooker's "Student's Flora" are closely followed. The species of Chara are taken from Prof. Babington's "Manual of British Botany." Mr. Backhouse is followed in the species of Hieracium; Prof. Babington in the Rubi; Mr. Baker in Wild Roses.

THE *Gardener's Chronicle* quotes from the *Illustration Horticole* that the recent International Botanical Exhibition at Florence yielded a net profit of 1,000*l*., and that the disposal of this sum to the best advantage of horticulture is under consideration.

A SCHOOL of Mines has been established by the Territorial Government at Golden, Colorado, one of the best places in the country for practical instruction.

THE Sixth Annual Report on the noxious, beneficial, and other insects of the State of Missouri has been issued.

MR. EDWARD BELLAMY, of the Charing Cross Hospital, has been appointed to deliver the course of lectures on the Anatomy of the Human Form, at the South Kensington Museum.

"ELEMENTARY Astronomy, or Notes and Questions on the Stars and Solar System" (Van Voorst), a small text-book for the use of schools, by C. C. Reeks, contains a great deal of recent and accurate information in small space, and seems calculated to serve the purpose for which it is intended.

THE additions to the Zoological Society's Gardens during the past week include an Australian Rail (*Rallus pectoralis*) from New Holland, presented by Mr. J. Harris; a Gannet (*Sula bassana*), European, presented by Mr. R. R. B. Norman; a White-winged Trumpeter (*Psophia leucoptera*) from S. America; a Dusky Monkey (*Semnopithecus obscurus*) from Malacca; a Pinche Monkey (*Midas œdipus*) from New Granada; a Bonnet Monkey (*Macacus radiatus*) from India, deposited.

*ON THE NECESSITY FOR PLACING PHYSICAL METEOROLOGY ON A RATIONAL BASIS.**

I WISH at the outset pointedly to disclaim originality in the main ideas to which I propose here to invite attention. The subject of my paper has occupied the thoughts of many men of science, with some of whom I have been in communication regarding it for several years. But though the conclusions to which I wish to lead you are the product of many minds, I am bound to accept to the fullest extent the self-imposed responsibility of bringing them forward at the present time and in the present form.

The branch of inquiry which has been very unsignificantly named Meteorology (meteoric phenomena being but slightly and remotely included in it) deals with the climate of the globe, and seeks to explain the vicissitudes of temperature and moisture, storm and calm, to which that globe is exposed. It is a subject of the highest importance to mankind generally, as affecting health, navigation, and agriculture; and possesses an interest acknowledged by every individual, from the savage to the *savant*, influencing as it does the personal well-being and daily comfort of all. Everyone discusses, and thinks himself competent to discuss, the weather.

My present object necessitates a broad classification of this department of inquiry into two main branches. The more obvious one of these, for which a fitting name has yet to be proposed, relates to changes of weather from day to day, and to the varieties of climate found in different localities. I shall not say much on this branch of Meteorology, but shall confine myself principally to the other main division, which has been named—I believe, first by Prof. Balfour Stewart—Physical Meteorology. Under this term are included, amongst other important matters, fluctuations in the seasons; the causes, external to the earth, which occasion or contribute to them; and the laws which regulate these fluctuations. The opinion is daily gaining ground that this branch of Meteorology has been unduly neglected, that it offers a magnificent field of inquiry and discovery, and that its vigorous cultivation must greatly aid the solution of those more limited and local inquiries to which observation has been hitherto more particularly applied. My present object is to urge the cultivation of this wide and almost unoccupied field of research and to point out some of the steps which should now be taken to that end.

It will be necessary for my purpose first to advert to some of the most elementary facts connected with Meteorology. Speaking in general terms, there are but four principal elements concerned in the production of all meteorological phenomena—the familiar elements of antiquity—fire, water, earth, and air. The part played by each is obvious to every observer.

Water, sucked up by heat from the ocean, and from the land which has imbibed it, falls again from the clouds in the form of rain, undergoing alternately, through excess of heat, evaporation and condensation. *The earth*, a great recipient of both heat and moisture, gives up each gradually and silently, and helps to maintain equability of temperature and of humidity. *The air*, set in motion by heat locally applied, becomes breeze, or wind, or storm, according to the amount, duration, and locality of that heat. In each of these three cases we see that an external force, heat, plays a conspicuous part. Can either of the three named elements, Water, Earth, or Air, perform its functions without the aid of that external force? Have they any innate power, enabling them to act independently of each other, or of all external forces? Will water, if left to itself at an unchangeable temperature, rise into vapour and fall in rain? What power resides in the earth to cause meteorological phenomena? It may possibly be replied that it boasts volcanic power, but as this exists only locally, it can play but a small part in the great economy of the whole earth. The internal heat of the globe may also be claimed as an independent attribute of the earth, and it may be so—but on this question we have as yet but very little reliable knowledge, though much interesting speculation. It may, however, be stated that, as an explanation of leading meteorological phenomena, the internal heat of the globe has not as yet been allowed much, if any, weight, though its use as a modifier of such phenomena may be considerable. As to the air, no innate power has hitherto been assigned to it. We may therefore, without much risk of error, regard water, earth and air, for the purpose of the present inquiry, as three forms of inert matter, capable of exercising independently no force whatever, but when acted upon, either separately or in combination, by heat, capable of producing the most stupendous results.

We come now to this heat—the sun. Has this any innate power? It seems almost needless to answer the question. The most familiar occurrences attest his paramount influence: the alternations of day and night, the march of the seasons, the daily variations of warmth—all bear testimony to his all-pervading and tremendous power.

It might seem superfluous to state facts which are almost truisms. But would it not seem to follow as a matter of course, needless to dwell upon, that such being the paramount influence of the sun, its study must be the first and most anxious object of solicitude to the meteorologist? Yet such is not the case. Obvious as are the facts I have briefly indicated, they have led to no such result. The reports and volumes of observations emanating from bodies and institutions charged with meteorological researches often do not contain even the name of the sun, and it may be broadly stated that the great central source of heat, and therefore of all meteorological activity, receives little or no attention in that capacity. I do not prefer this as an indictment against those to whom I refer. Many reasons may be assigned for their total neglect of the sun. Perhaps amongst the most valid is the fact that instrumental appliances fitted for the purpose have not, until within a comparatively recent period, existed.

---

* By Lieut.-Col. A. Strange, F.R.S., Inspector of Scientific Instruments to the Indian Government; a paper read at the British Association.

Another powerful reason no doubt is to be found in the difficulty with which even cultivated scientific minds can be brought to recognise, as a truth to be practically acted on, that no science stands alone, that all are intimately connected by nature, and that the classification and separation of various branches of inquiry is an artificial arrangement of man, adopted for the more convenient division of labour.

The time seems to have arrived when we ought to apply this truth to the science of meteorology, and to bring to its aid a class of researches calculated to provide it with that secure and rational basis of which at present it is absolutely destitute.

Before passing to a consideration of the steps which seem necessary to this end, I will touch slightly on one of the objects the hope to attain which fully justifies their being taken. I allude to the hope that we may thereby find some explanation and some law for the fluctuations of the seasons.

In a given locality, on a given date, the sun, to whom we ascribe so predominating an influence, attains, year after year, the same elevation above the horizon, and being at the same distance, presents the same angular area. If the sun, as that date annually recurs, were in all other respects the same, we should have a right to expect an annual recurrence of the same weather, unless some disturbing cause, of which we have at present no knowledge, were known to exist. I do not say positively that the sun being a constant force, we should have this constancy in the seasons—but what I do say is, that if the sun be not a constant force, we have no right to expect constancy in the seasons. The first question, therefore, should be: Is the sun a constant force? Does it, year after year, at the same date, present the same unvaried surface? We know that the contrary is the case.

We know that the surface of the sun's disc is never free from spots, and that these spots are constantly changing in number, size, and position: we know that whatever law may govern them, their period of change and return is certainly not annual.

We know also that the general surface of the sun is covered with markings called faculæ, which are perpetually changing, and which have not an annual period. We have also learnt, within two or three years, by the aid of the spectroscope, how at any time to examine the exterior gaseous envelope of the sun, which formerly could only be seen during a total eclipse, and we now know that the famous red prominences of which on those rare occasions we obtained only a fleeting glimpse, on being studied at our ease, without interruption, reveal evidence of activity in those regions of the most stupendous sublimity, darting out, in a few seconds, flames many thousands of miles in extent. Further, in examining the spectrum of the solar light with improved spectroscopes assisted by photography, we find that thousands of lines exist there of which hitherto we had no knowledge—and quite recently the researches of Norman Lockyer tend to throw a doubt on the fixity and constancy of some of these lines.

We have here evidence which conclusively proves that the sun's surface and surroundings are not maintained in a constant condition. The evidence may not justify us in asserting that as his surface changes so must the force which he pours out on the earth necessarily change also; but it certainly justifies us in entering on a systematic examination of that question with the appliances which modern physical astronomers have contrived for the purpose.

In what, then, should this systematic study of the sun consist? Up to the present time the spots have been the main object of study. Most valuable observations on these have been made, of which those of Carrington, of Howlett, of Selwyn, and of the Kew Observatory under the auspices and direction of Warren De la Rue and Balfour Stewart, may be mentioned as the most complete and most long-continued. But excellent as these series are, and great as is their value, this consists chiefly in their having shown the extent and character of the work that has to be done. They labour under the unavoidable defect of frequent interruption by cloudy weather—about two-thirds of the year are thus lost in England, and the evidence afforded by the remaining one-third is diminished in value. But even some of these researches have now been discontinued—in the case of Kew, for want of the requisite funds.

The conclusion arrived at by those who have devoted themselves to the subject is that a *daily record* of the changes taking place on the sun's surface is necessary. I will here advert only to the changes in the spots. These we already know do not take place arbitrarily: they gradually increase in aggregate area to a maximum, and as gradually decrease to a minimum—their period having been provisionally fixed at about 11¼ years. But this period has been derived from observations of all the spots visible, without discrimination—and the "spotted area" is the aggregate area of all such spots. There is, however, reason to suspect that if it were possible to trace each individual spot throughout its existence, from its first formation to its final disappearance, there would be found to be different classes of spots having very different durations and perhaps very different maximum and minimum periods; and a reduction of these classes separately might, and probably would, result in a considerable modification of of the present 11¼ years cycle, and possibly in the discovery of other cycles, at present masked in the period determined from all spots taken indiscriminately. But hitherto the absence of anything approaching a daily record of the spots has precluded any attempt to classify them. What is true of the spots is also probably true of all other manifestations of solar energy.

With respect to sun-spot researches, it fortunately happens that the photographic records need not be all taken at the same station. The record of one day taken in England can be combined with the record of the next day taken at the other side of the globe. Hence, in order to obtain this daily record it is only necessary to select a certain number of stations in localities such that there shall always be clear weather at one of them. India offers peculiar facilities for such a selection of stations, owing to the great variety of climate to be found in that country during the same period of the year. Perhaps four or five such stations would suffice for India, and if absolute continuity of record could not be obtained by them, the deficiencies could easily be made good by stations in our colonial possessions.

I think it hardly necessary that I should state that in advocating this system of continuous solar record I do not intend that other methods of meteorological research, now in use, should be abandoned. It is obvious that both methods must be employed. Whether present methods do not admit of considerable extension and improvement, is a very important question, on which, however, I do not here propose to enter. Nor do I intend to discuss the question whether the sun stations now advocated should not also be meteorological stations in the ordinary sense. This, like many other such questions which will have to be settled, is an administrative detail, which I shall not step aside from the consideration of fundamental principles to discuss.

It is scarcely necessary to point out that such a system of daily solar record as I have indicated is beyond the reach of individuals, and must, if attempted at all, be established and maintained by the State. The degree and direction in which the State should aid the advancement of science has been much debated of late, and the British Association has contributed powerfully, by obtaining a Royal Commission presided over by the Duke of Devonshire, to the solution of this difficult problem. As I have taken a part in these discussions, and have given considerable attention to the subject, I may perhaps, without impropriety, here state what appear to be the principles applicable to the particular case we are now concerned with.

The first principle is that private enterprise should not only be allowed the most perfect freedom from interference or competition by the State, but that it should be encouraged and aided in every possible way.

The second principle is that the State should step in where private enterprise fails, and itself conduct scientific research, whether observational or experimental, subject to the following main conditions:—

(*a*) That the probable results of the research will be beneficial, in the widest sense of that term, to the community at large, or to the various departments of the State.

(*b*) That the research is too costly, or commercially too unremunerative, to be undertaken and vigorously prosecuted by individuals.

(*c*) That the research requires continuous uninterrupted work extending over very long periods, and conducted by systematically organised establishments.

Probably no case could be mentioned as so completely satisfying these three conditions as that of researches affecting *closely* every interest in the community, needing for their conduct a number of well-equipped establishments, maintained, not merely for many years, but certainly for generations—possibly for centuries. This is work which it is futile to demand from individuals.

I wish to guard against being thought to assert that the study of the sun will certainly solve all the enigmas of meteorology. I do assert that the strongest possible *primâ facie* has been made out against the sun as the principal ringleader in meteorological agitation—and that there are ample grounds for putting him on his trial. Let us however suppose the impossible case of his absolute acquittal, I maintain that this negative result would be worth all the labour of obtaining it—eliminating, as it would do, one, and that the most conspicuous of probable causes, and so narrowing our inquiries to those that remain. The more likely event, however, will be that whilst the sun will be proved to be the chief promoter of these disturbances, his accomplices, and their various degrees of participation, will be dragged more prominently before the light.

Nor do I desire that the "innate power" I have attributed to the sun, and denied to other elements, should be misunderstood. I have used the term as the only one available to mark strongly the relative influences at work. I by no means intend to use the word "*innate*" in an absolute sense, or even to imply that the forces of the sun are self-generated and self-maintained. The object of this paper is a strictly practical one, and is not to be taken as intended to contribute one word to speculations on the constitution of the sun. But though disclaiming speculation, I may, on behalf of my practical object, point out that we already possess what may at least be claimed to be presumptive evidence that the sun is not exempt from external influences. I allude to the remarkable apparent connection which the researches of De la Rue, Stewart, and Loewy, have established between the behaviour of the sun-spots and the positions of some of the planets, particularly Venus, the Earth, and Jupiter. I say that the mention of a result so well calculated to excite speculation, aids my practical object. I mean that by following up the hint given us by these most remarkable researches, we may be led to a more complete knowledge and more philosophical conception of the structure of the universe.

And I would here remark that I have urged the study of the sun from the meteorological point of view in order to give a practical justification for the adoption of definite practical steps. But that study is recommended by even higher considerations still, by the insight it must give us into cosmical relations, and the help it will afford us in seeking to understand something, if not of first causes, at least of causes of the highest order that our limited intelligence can grasp and reason on.

The more one reflects on the neglect of the sun justly chargeable against us, the more one wonders at it. It is like the case of a man placed before a steam-engine for the first time, and seeking to learn its principle and action by counting and measuring the bolts, screws, and rods, without giving a moment's attention to the source of power—the furnace and boiler. What they are to the steam-engine the sun is to us, and it is astounding that men should dare to undertake a solution of the complex and mysterious fabric which surrounds us without giving a foremost place in their investigations to the source of all material life and power.

Civilisation has been variously described and defined. It seems to me to imply above all things *completeness*. It aims at supplying all wants, at removing all obstacles to thought and to action, at making good all deficiencies, at remedying all evils moral and material, at guarding against all dangers, at promoting all beneficence, at extending and perfecting all knowledge. Science, as the most potent guide and instrument of civilisation, needs also to be complete. A harp with broken strings can discourse no music,—a chain with unconnected links can sustain no weight. Science, as our President so eloquently impressed upon us in the address with which he opened this Section, is one and indivisible. It has been broken up by man into its various recognised branches to serve his convenience and to assist the weakness of his intelligence; but nothing, as the same authority told us, is more subversive of truth and more hindering to progress than to regard these subdivisions as representing the actual order of nature. There must be doors of communication between the observatory, the laboratory, and the mathematician's study. The isolation of particular fields of research is no longer tolerable: each passes, however indirectly and insensibly, into the other through that "border land" which, as our President reminded us, "recent investigation has shown to be so fertile of discovery."

The study of the sun stands on this "border land." It belongs but very partially to the domain of the ancient astronomy, it possesses some holding in the provinces of chemistry and geology, and more still in that of physics, it claims as its right (as what branch of science does not?) the devotion of the mathematician, and it rules almost supreme in meteorology.

This study asks to be recognised and provided for. How much longer will the demand be disregarded?

IN WHAT WAY AND AT WHAT STAGE CAN TECHNICAL INSTRUCTION BE BEST INTRODUCED INTO OUR SYSTEM OF NATIONAL EDUCATION[*]

IT will simplify the consideration of the subject, the discussion of which I have been requested to introduce, if we admit frankly that in England at any rate (I am glad to believe that Scotland is more fortunate) we do not possess a system of national education. Such a system, as I conceive it, should afford to all the children of the nation adequate elementary instruction, and, moreover, should offer to all, so far as their capacities and other circumstances will enable them to take advantage of it, full opportunity for further mental cultivation. There are lying before me the calendars of two German schools for boys of the middle class intended for a mercantile or industrial career: the Friedrich-Werder Gewerbe, or Trade School of Berlin, and the Real Schule, under the direction of Dr. Schellen at Cologne. The courses of each of these institutions following after some preparatory teaching in an elementary school or at home, where reading and writing together with a little arithmetic have been acquired, retain their pupils during nine or ten years; and boys who, according to the reports, were to become mechanical engineers, builders, postmasters, merchants, and chemists, left those schools last July, having attained the ages of seventeen to twenty years. The Real Schule of Cologne, the average number of whose pupils is 580, has 28 masters; the Gewerbe Schule of Berlin, averaging 540, has a staff of 32 masters. In every German town of the least importance there are, in addition to the Gymnasium or Classical School, one or more technical schools resembling those of Berlin and Cologne; the numerous Universities and Polytechnic Institutions furnish the requisite staff of teachers. The fees are small. I have no information as to those of the schools which I have quoted, but I find from the prospectus of another very celebrated trade school, that of Barmen in Westphalia, that its school fees for the year are from 3*l.* in the lowest to 6*l.* in the highest class, and that boys whose friends do not reside in the town are boarded for 25*l.* The governments, the municipalities, and private persons vie with each other in placing at the disposal of poor scholars of the elementary schools who have shown superior capacity, the means of continuing their studies in these secondary schools.

I need not describe the elementary schools of Germany and Switzerland; it is now well known that, in them, the children of the poor receive, up to the age of fourteen years, sound elementary instruction, not confined to reading, writing, and arithmetic, but including geography, the outlines of the history of their own and other European countries, a modern language, some elementary teaching in science, and instruction in the religion which their parents acknowledge.

As contrasted with a system of education such as I have referred to and excluding the great public schools, available only to the rich, we have in England for the middle classes schools like those attached to King's and University Colleges, the City of London School, the Bristol Trades School, and, thanks to the Endowed Schools Commissioners, a few efficient or at any rate progressive grammar and endowed schools, amongst which I would more particularly name the school at Giggleswick, near Skipton, as one where instruction in science has been included in the general plan of instruction; and a small number of exceptional private schools in which a praiseworthy attempt is made to adapt the instruction to the requirements of industrial and commercial classes. These schools however rarely retain their pupils beyond the age of fifteen to seventeen years, and when all are reckoned they are utterly inadequate to the wants of the population.

Of elementary school buildings we shall soon have a sufficient number, and it is probable that the duty of the parent to send his child to school will, in some way or other, be in all cases made a legal obligation; but so long as the necessity of rendering our training schools for elementary teachers thoroughly national and efficient is not acknowledged, and so long as the instruction of the children in elementary schools is left in a great measure to the care of other ill-taught children, called pupil-teachers, of from thirteen to seventeen years of age, we cannot hope that our poor will receive proper elementary instruction.

Until the English approach the German schools in number and value it would be vain to expect that technical instruction will be universally accessible, and we can only hope for its gradual introduction, availing ourselves of existing resources, with such improvements as may be looked for under the stimulus of the increasing interest evinced by some of our great corporations, by the parents themselves, and consequently by the Legislature.

---

[*] A paper read before the Social Science Association, Oct. 1, by Mr. B. Samuelson, M.P.

One important step in the right direction has lately been taken:—Although the political chief is still a species of odd man whose duties include the passing of Ballot Acts, the suppression of foot-and-mouth disease, and the negotiation of Washington Treaties, the Government departments of literary instruction and of Science and Art have been placed under the control of a single permanent administrative head.

I understand technical instruction to include, besides the teaching of industrial manipulation, which for our present purpose we may exclude, firstly, drawing, mathematics, and the physical sciences, which are the bases of the industrial arts; and secondly, the application of those sciences and of the art of design to industrial purposes. I should place in the first division such subjects as:—

Pure Mathematics.
Geometry.
Theoretical Mechanics.
Chemistry.
Physics.
Geology.
Physical Geography.
Biology.
Astronomy, &c.;

and in the second—

Building Construction.
Naval Architecture.
Applied Mechanics.
Machine Construction.
Chemical and Manufacturing Technology.
Metallurgy.
Agriculture, &c.

Although this list is incomplete, it will be obvious that the field is too wide to be covered within the school period, even when the pupils remain at school to the age of adolescence; bearing in mind always that instruction in technical subjects to the exclusion of other branches of a liberal education would defeat its own object. Much more is this the case with children leaving school between the ages of thirteen and sixteen. The choice of subjects must vary with the age at which school instruction is to terminate, and with the future career of the scholar.

A condition precedent, however, to the possibility of technical instruction is a due provision of science teachers. For these we must look, in the main, as to elementary schools, to our training colleges, assisted by such institutions as the Science School of South Kensington, and as to secondary schools, to the Universities, and to institutions like King's College, University College, and Owens College. The training colleges should add a third year to their curriculum; instruction in mathematics and in some of the other subjects which I have included in the first division should be part of the obligatory course; and no elementary school containing, for example, 100 children and upwards should, after a certain date, receive the Parliamentary grant on results, unless it had a teacher who had passed satisfactorily in Geometry, in Physical Geography, and in Physics or in Biology. A man thus qualified, having become familiar with the method of science, could, if he chose, afterwards acquire other theoretical subjects as well as those of application, included in the second division; for instance, machine construction, chemical technology, or agriculture—availing himself for that purpose, as to the first class of subjects, of the annual courses for elementary teachers at South Kensington, or of any other means of instruction which may be within his reach. But if he stopped short at the limited but exact instruction in theoretical science which I suppose him to have obtained in the training college, he would be infinitely better qualified as a teacher than if during that course he had taken up a greater range of subjects superficially. Whether he be competent to teach many subjects or not, the children of the elementary schools whom he is to instruct have not time to acquire more than the rudiments of one or two theoretical sciences. At the same time an elementary teacher, who is qualified to give instruction in the applied sciences, will find employment in adult classes, such as those in connection with the Science and Art Department.

Assuming, then, that every elementary school for 100 pupils and upwards, which would include the principal village schools, had a master or assistant qualified in science, the course of such a school should include, for all the children, linear drawing and lessons on common objects which would be illustrated by locally accessible specimens; [the ordinary reading-book should also describe in familiar language the phenomena of nature. Those who are acquainted with the admirable text-books on Elementary Science of Prof. Balfour Stewart, Dr. Roscoe, and others, cannot doubt that the task of compiling such a reading-book will be undertaken by competent hands, as soon as the want of it becomes felt. Indeed, I am not sure that it does not already exist amongst the publications of the Irish National Board. The older children, those between the ages of ten and thirteen, should receive instruction in Physical Geography, in the elements of Trigonometry, and, from the age of eleven or twelve, in the rudiments of Biology or of Physics, perhaps, in some exceptional cases, of both. More cannot be done for them in the elementary school; a few should be drafted into the secondary school; but the greater number would at the age of thirteen become full time-workers in the field, at the bench, or in the factory; possessing, however, as is now but rarely the case, the elementary instruction required for taking advantage in their leisure hours of the science classes which are to be found in almost every district of the United Kingdom. How much may be done there is evident from the success of the Andersonian University in your city, with its 1,400 students, to whose founder belongs the honour of having been, more than a century ago, the originator of scientific instruction to the working classes. Children thus taught from the commencement by such masters, when they afterwards receive instruction in science, would not be subjected to, and would revolt against, cram like that recorded in the Report of the Science and Art Department for the present year, in which Prof. Ramsay, the examiner in Geology, says that "candidates answer one of last year's questions in place of one of this year's, as if they had been specially crammed in last year's examination;" and Prof. Carey Foster, acting with Dr. Tyndall as examiner in Acoustics, Light, and Heat, states that a good number of candidates in the advanced stage "suppose that in order to *damp* the vibrations of a string it is needful to *wet* the string," and "that a ship is the kind of vessel that would usually be employed for containing air."

Amongst other conspicuous examples of adult instruction in science given to the class whose education has been received in elementary schools I may name the lectures for working men of Owens College, numbering more than 600 students, under the gratuitous tuition of the professors of that institution, and those of the Miners' Association of Cornwall and Devon, organised some dozen years ago by Mr. Robert Hunt, F.R.S., Keeper of Mining Records, whose teachers seek out the working miner in his village and make him familiar with the laws of the forces and the properties of the matter with which he is brought into contact in his daily work. But time is wanting to allude further to the subject of adult elementary instruction in science, nor will I enter into the question of science teaching in our great public schools, which has been inquired into by Mr. Norman Lockyer, F.R.S., the secretary of the Royal Commission on Scientific Instruction, whose report will doubtless be forthcoming before long.

In secondary schools, assuming the existence of competent teachers, and that they retain their scholars from the age of eight or nine to sixteen or seventeen—I should commence, as in the elementary school, with lessons in drawing and on familiar objects, and in Physical Geography; and introduce Mathematics, beginning with Geometry at the age of eleven or twelve, continuing it until the pupil leaves school; systematic instruction in the elements of natural science might begin at the age of ten to eleven with Natural History, including Geology; and the six years until the pupil leaves at the age of sixteen or seventeen could be made readily to include successively the elements of that science and of Physics and Chemistry. With the exception perhaps of applied mechanics, it would not in my opinion be possible to include the applied sciences, but the teacher would illustrate his instruction by practical applications. Work in the laboratory is a necessity if a thorough appreciation in kind, however limited in extent, of natural science is to be acquired; but the experience of the Rev. W. Tuckwell, of the College School at Taunton, communicated to the British Association, and of others, shows that a school laboratory need not cost more than 200*l*. to 400*l*.

Only in those cases where school education is continued to the age of eighteen or nineteen years would it be desirable to introduce such subjects as building, or machine construction, or chemical technology. In all other cases more *real progress* would be made by devoting all the available time to theoretical science. The scholar who enters into active life as an apprentice at the age of sixteen or seventeen, would see in the workshop the application of the principles which he would have learnt at school, and, if diligent, he would find opportunities of further study in adult classes, in factories, and in text-books on special subjects. For instruction in the entire range of theoretical and applied science it would be necessary that the student should continue the course, commenced during the school age, at the University or at a Polytechnic Institution such as there is now some hope that the Science School at South Kensington may become.

Although I have excluded instruction in technical manipulation from the subject of this paper, I think it right to add that the students of King's College and of King's College School save much time and drudgery during their pupilage by the practical skill acquired in the workshops attached to the College, and that according to competent observers like Mr. Nussey, of Leeds, the artisans of Elberfeldt, Crefeld, and other continental towns derive great advantage from the schools of design and so-called weaving schools.

I should not fulfil my duty if I were to conclude this paper without acknowledging, though no alarmist in regard to foreign competition, that other nations, less energetic, less rich in accumulated capital and practical experience, and without the advantage of our great mineral resources, are, thanks in a great measure to their superior technical training, making relatively greater advances than ourselves in many branches of industry, and that the conviction of the necessity for such training has not arisen amongst ourselves a day too soon. Happily it has arisen, and in the most desirable quarters. Manchester, by the judicious enlargement of Owens College, to which its merchants and manufacturers have quite recently contributed a sum approaching 200,000*l.*; Yorkshire, by the establishment of the College of Science at Leeds, to which secondary schools of science are to be affiliated; the Company of Clothworkers, by the foundation of scholarships, and the endowment of a chair of textile technology in the Yorkshire College; the University of Durham, and the coal-owners and manufacturers of the North of England, by their joint foundation of the School of Science at Newcastle; Oxford, by its patronage of the College to be established at Bristol; and the Company of Merchant Adventurers, by the aid which it is giving to the Trade School of the same city—are not only directly promoting the higher technical instruction amongst the populations in which their work is done, but will furnish competent teachers to the elementary and secondary schools of their own and other localities. I think there is no fear that a work of such national importance once so actively begun will suffer any relapse; but it will be in the power of this Association to promote by discussion and advice its intelligent and economical organisation.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Oct. 5.—M. Bertrand in the chair.—The following papers were read:—Researches on the conditions of resistance in cylindrical boilers, by M. H. Resal.—On the exact values of the angles in the crystals of titaniferous iron, by M. N. de Kokscharow.—Report on the machine for freezing by the evaporation of methylic ether, invented by M. Ch. Tellier; and on the preservation of meat in the air, cooled by this apparatus, by the Commissioners, MM. Milne-Edwards, Peligot, and Bouley.—On the temperature of the sun, by M. J. Violle. The author starts with the fundamental equation $\alpha^{\theta} - \alpha^{t} = \frac{\omega}{s}\alpha^{e}$, and, from determinations of the intensity of solar radiation assigns the value 1550° to what he calls the *effective temperature* of the sun. The true mean temperature of the surface of the sun is estimated at 2,000°.—Note on magnetism, by M. J. M. Gaugain, a continuation of former researches.—Seventh note on the conductivity of ligneous bodies, and of other substances which are bad conductors, by M. Th. du Moncel.—Experimental researches on explosive substances, by MM. Roux and Sarrau.—On a register giving continuous indications for the determination of the law of variation of pressures produced by the gases of gunpowder, by M. Ricq.—On the synthesis of purpurine, and of some analogous colouring matters, by M. A. Rosenstiehl.—New observations on the chemical composition of the waters of Bagnères-de-Luchon, by M. E. Filhol.—Method of determination of copper by means of titrated liquids, by M. Pr. Lagrange.—Comparative and critical examination of the hypotheses which have been advanced to explain the figure of comets and the acceleration of their motion, by M. H. Champion. The author attempts to show in this memoir: (1) that a force directed along the radius vector develops in the two opposite parts of an elliptical orbit separated by the major axis, two tangential components of contrary signs, of which the effects are exactly compensating; (2), that the force gives rise to a third component opposed to gravitation, of which the final result is to increase the dimensions of the orbit; (3), it is shown that at the distance at which comets' tails commence to be seen, the rays of the sun would not produce an appreciable elevation of temperature in a highly rarefied substance.—On the comparative chemical composition of the different parts of the vine when healthy and when attacked by *Phylloxera*, by M. Boutin.—Experiments made at Cognac on phylloxerised vines with the coal-tar recommended by M. Petit, by M. P. Mouillefert.—Experiments made at Montpelier with the same substance, by M. Alph. Rommier.—Observations on the points gained by science concerning the known species of the genus *Phylloxera*; a letter from M. Signoret to the perpetual secretary.—Observations concerning the recent communication of M. Balbiani on the different known species of the genus *Phylloxera*, by M. Lichtenstein.—Trial of infection of a healthy vine by putting *Phylloxera* in contact with its roots, by M. Delorme.—On the means proposed to check the propagation of *Phylloxera*, the method of uprooting in particular, by M. P. Naudin.—Experiments on a method of treatment of phylloxerised vines, by the sap of a Euphorbia, by M. L. Balme.—On the appearance of *Phylloxera* in the canton of Geneva, and on different curative measures proposed, by M. E. Ador.—The Minister of Foreign Affairs transmitted further details of the recent eruption of Etna.—M. Dumas announced that the news received from the first four Transit of Venus expeditions was satisfactory on all points.—On the pretended Saharan Sea, by M. A. Pomel.—Observations on the ancient central sea of the Tuniso-Algerian Sahara, by M. Virlet d'Aoust.—On the theory of curves in space of *n* dimensions, by M. C. Jordan.—Electro-diapason of variable period, by M. E. Mercadier.—Electro-spectral tube, or "fulgurator," for the observation of the spectra of metallic solutions, by MM. B. Delachanal and A. Mermet.—Note on supersaturation, by M. Lecoq de Boisbaudran.—On the action of bromine on certain alcohols, by M. E. Hardy.—Note on the production of oxamic acid by the oxidation of glycocol, by M. R. Engel.—Action of heat on diphenylmethane and phenyl-toluene; on the products of the reduction of benzophenone, by M. Ph. Barbier.—Curious association of garnet, idiocrase and datholite, by M. J. Lawrence Smith.—Balloon meteorological observations, by M. G. Tissandier.—Note on the spectroscopic observations made during the balloon ascent of Sept. 24, for studying variations in the extension of the colours of the spectrum, by M. W. de Fonvielle.—On the feeble influence which diluvian waters have exercised on the formation of the valleys of the Paris basin, by M. E. Robert.

BOOKS RECEIVED

BRITISH.—Synopsis of an Arrangement of Invertebrate Animals in the Free Museum of Liverpool, with Introduction by Rev. H. R. Higgins (Marples).—Babington's Manual of British Botany. 7th edit. (Van Voorst).—Mineralogy: Frank Rutley, F.G.S (T. Murby).—The Sanitary Condition of Oxfordshire: G. W. Child (Longmans).—Symond's Rainfall for 1873.—Sixteenth Report of the East Kent Natural History Society (Canterbury).—Amateur's Photographic Guide Book: Stillman (Smith, C.D.).—The Principles of Modern Pantheistic and Atheistic Philosophy: C. A. Row (Hardwicke).—Micrographic Dictionary. Parts xiii. and xiv.: Griffith and Henfrey (Van Voorst).

CONTENTS

PAGE

THE UNIVERSITIES COMMISSION REPORT, I. 475
METEOROLOGICAL REFORM. By Prof. BALFOUR STEWART, F.R.S. . 476
VAN DER WAALS ON THE CONTINUITY OF THE GASEOUS AND LIQUID STATES. By Prof. J. CLERK-MAXWELL, F.R.S. 477
LETTERS TO THE EDITOR:—
    An Anagram.—WEST 480
    "Manufactured Articles."—C. J. MONRO 481
    Yorkshire College of Science.—R. REYNOLDS 481
    On the Process of Tone-making in Organ-pipes.—HERMANN SMITH 481
    Can Land-crabs Live under Water?—Prof. J. MARSHALL, F.R.S . 482
    Bright Meteors.—HENRY H. HIGGINS; A. BALDING 482
    Rainbows.—GEORGE J. ROMANES (*With Illustrations*), JOHN LATCHMORE, Jun 483
    The Cry of the Frog.—F. BADEN BENGER 483
    The Edible Frog.—SAML. H. MILLER 483
SOUNDINGS AND CURRENTS IN THE NORTH PACIFIC OCEAN (*With Illustrations*) 484
NATURAL HISTORY NOTES FROM SOUTH AFRICA 486
JEFFRIES WYMAN, M.D. 487
LECTURES IN NATURAL SCIENCES AT CAMBRIDGE 488
NOTES 488
ON THE NECESSITY FOR PLACING PHYSICAL METEOROLOGY ON A RATIONAL BASIS. By Lieut.-Col. STRANGE, F.R.S. 490
IN WHAT WAY AND AT WHAT STAGE CAN TECHNICAL INSTRUCTION BE BEST INTRODUCED INTO OUR SYSTEM OF NATIONAL EDUCATION. By Mr. B. SAMUELSON, M.P. 492
SOCIETIES AND ACADEMIES 494
BOOKS RECEIVED 494

THURSDAY, OCTOBER 22, 1874

THE UNIVERSITIES COMMISSION REPORT*

II.

IT has of course been always well known that the endowments of Oxford and Cambridge have been by law restricted, till within the last few years, to members of the Established Church; but to the outside world it will probably be a surprise to learn from this Report how far-reaching have been the consequences of this restriction, and how deep is the ecclesiastical character which has been thus imprinted upon a large portion of the academical wealth which the nation imagines to be at its own free disposal. It must be premised that in this respect, as in so many others, Oxford furnishes far more matter for comment than Cambridge, so that the following illustrations will be mainly taken from the former University; and also that it is regularly in the most wealthy Colleges that ecclesiastical objects receive a disproportionate amount of pecuniary aid: two circumstances which point to the conclusion that it is superfluity of income which causes the interests of education and learning to be cast into comparative neglect.

The synoptical tables at the end of this volume state that the Oxford Colleges have in their gift or annexed to their Headships 436 benefices of the returned annual value of 187,000*l.* It is notorious that these returns are considerably below the gross amount actually received, but as they stand they represent a sum equal to more than two-thirds of the total amount which these same Colleges receive from their corporate endowments. The proportion at Cambridge is not quite so large. Some of the Colleges have exercised their statutory powers of selling their advowsons, but to no great extent, and it is yet a moot legal point whether the money produced from such sales can be diverted to purely secular objects. It is noticed, however, by the Commissioners, that in one or two cases such money has been carried to the ordinary account, and that in others it has been appropriated to purposes which otherwise must have been paid for out of the corporate revenue. The proper disposition of the wealth represented by these advowsons is clearly one of those questions which should not be left to the varying and self-interested action of the individual Colleges, but must be resolutely faced by Parliament, and if it be decided in the way which the progress of modern opinion seems most disposed to favour, there will result a very large increase on the total of 260,000*l.* a year mentioned last week as the clear sum available in the reconsideration of the endowments of Oxford. According to another heading in the synoptical tables the total sum of 8,600*l.* is expended upon the College chapels at Oxford, a total which will probably not be considered too large, when it is also stated that out of it are maintained the great choral services at Magdalen, New, and Christ Church, at an average of more than 2,000*l.* each. This sum, however, deserves quotation, if only out of contrast with the item which follows under the head of "Library," which amounts at Oxford to the bare pittance of 1,300*l.* Here also the amounts expended at Cambridge upon the ecclesiastical and secular establishments stand in a similar proportion. It is true that the libraries are awarded something besides from Trust funds and from fees on graduation, but the circumstance that their wants are so conspicuously put into the second place is most significant of the general tone of feeling prevalent at the Universities on these matters.

Another item in these tables is headed "Subscriptions and Pensions," amounting at Oxford to close upon 9,000*l.*, which may not perhaps seem an extravagant expenditure for the owners in fee of so much landed property; yet it will be viewed with much suspicion by those who know how feeble College meetings are in their resistance to the importunities of past members of their body seeking pecuniary help for all those objects which the Church of England takes upon itself to perform in rural parishes. The part of this subject, however, which is destined to attract the largest amount of public attention is that which has reference to the augmentation of College benefices out of corporate income, a process by which, as was before tolerably well known, the clerical fellows, forming as they do a majority in the governing bodies, provide comfortable pensions for their own declining years, and at the same time evince their interest in the general welfare of the Church. The extent, however, to which this process has been carried on is now revealed for the first time, though it is not quite apparent whether all has yet been disclosed, for in the course of their inquiries on this topic the Commissioners have not unnaturally been met with considerable reluctance, and in some cases apparently even with evasion. The synoptical tables for the Oxford Colleges give the amount thus annually devoted as just 9,000*l.*, which may be thought a fully sufficient charge for this item, being more than is set apart for College officers, for the management of estates, or for investment. This figure, however, it cannot be too widely known, is a totally delusive one, and probably does not represent one quarter of the amount which is really squandered in this way. This conclusion would be at once suspected by anyone who has an inkling of the facts, when he reads that Queen's is credited in this table with nothing at all, and Magdalen with only 17*l.* 10*s.* A more particular examination of the full returns made by the individual Colleges amply confirms these suspicions by proving, though in a roundabout way, that Queen's really pays away to incumbents 3,000*l.* a year, and Magdalen no less than 9,000*l.* To this it may be added that Christ Church, which in the tables is only credited with 2,000*l.*, does as a matter of fact spend just four times that amount; and that since 1835, and chiefly within the last few years, has given away 28,000*l.* for cognate ecclesiastical purposes. In connection with this subject, it may be mentioned that Magdalen possesses a certain benefaction called the Sheppard Fund, subject to no specific conditions, except that the proceeds are to be appropriated "to such uses as are likely to promote piety and learning in Magdalen or any other College." Out of a net 2,000*l.* a year received from this fund, 300*l.* is spent on management, &c., the ambiguous item of subscriptions runs away with 470*l.*, while 720*l.* is swallowed up in ecclesiastical objects, leaving a bare 540*l.* for Magdalen College and other schools. The accounts of the Hulme Trust connected with Brasenose teach the same lesson, for in that case no less than 4,000*l.* per annum out of a net revenue of 6,000*l.*, under the authority, it is true, of recent Acts of Parliament, is devoted to livings and churches; a considerable deviation, as the Commissioners observe, from the intention expressed in the will of the benefactor. The returns of the value of the Professorships are equally significant, for the five Divinity Chairs are each endowed with 1,500*l.* and a house, whereas the average of the remaining Professorships cannot be more than 500*l.* without a residence. It may here be incidentally mentioned that the collective income of the Oxford Professors from all sources amounts to 25,000*l.*, of which only 450*l.* comes from fees, and more than half of this latter sum from the fees of the four Science Professors.

---

* Continued from p 476.

Concerning the number of Fellowships confined to those who have taken or who have promised to take orders, this Report is entirely silent, on the same principle apparently as it omits to state what proportion of the College endowments is appropriated to the encouragement of Physical Science. For information on this latter topic, recourse may be had to the Report of another Royal Commission lately published, and the University Calendars yield some evidence on the former point. As to Oxford, it has been calculated that with the exception of Merton, where for the future all Fellowships, as well as the Headship, will be entirely open, nearly half the Fellowships are what is commonly called clerical, and all the remaining Headships are confined to clergymen. The proportion in the different Colleges is very irregular, but the reader will hardly be surprised to learn that, in accordance with what has been intimated above, at the four wealthiest Colleges the proportion is as high as two clerical fellows to one lay.

All these facts, and there are more of the same character, seem to point one way: that when the reconstruction of the Universities becomes a matter of public and not special interest, and when the uses to which their endowments are put shall be fundamentally reconsidered in the light of modern experience, one of the first questions which the nation will have to decide for itself will be whether so large a portion of academical property shall in the future be limited to purposes which certainly are not educational, and nowhere else than in England would ever be thought to be academical. That the Colleges themselves cannot be permitted to settle these great questions at their own sweet will is abundantly made clear by the facts recorded in this Report. It may be granted that the reformed statutes of a few of the Oxford Colleges, which are appended at the end of this volume, promise to abolish certain of the more prominent evils in their constitution, which evils indeed nowhere find any active defenders; but in none of these schemes is adequate importance attached to the duty of encouraging original research, the one part of its academical functions which Oxford neither performs nor regrets to have left unperformed. Moreover, the well-intentioned activity of some three or four of the less wealthy Colleges affords no guarantee that the greater institutions will not continue in their wasteful courses, and permit fresh vested interests to be acquired daily. Perhaps public opinion is not yet fully ripe, and perhaps those who have interested themselves in these subjects are not yet sufficiently unanimous; but for the future, at any rate, no excuses of this kind ought to be tolerated. The Commission on Scientific Instruction and the Advancement of Science has thrown into shape a scheme of reform which, though primarily adapted to the case of original research in the physical sciences, is capable of being extended to similar branches of genuine study, and to the outline of that scheme many prominent men, statesmen and others, have given in their adhesion. This Commission has now in its Report given us all the materials requisite for discovering where the necessary funds shall come from; and from henceforth it will be only due to laziness, or to individual perversity, if a definite scheme of University Re-organisation, conceived in the interests of unencumbered investigation and mature study, is not soon presented for the acceptance of the public.

SEDLEY TAYLOR'S "SOUND"

Sound and Music: a Non-mathematical Treatise. By Sedley Taylor, M.A. (London: Macmillan and Co.)

FINDING from the title-page and preface that this work, though non-mathematical, undertakes to give an account of the acoustical discoveries of Helmholtz, we acknowledge having felt some misgivings when we commenced the perusal of it. We will presently inform our readers whether we found our fears justified or not by the book itself; but we must first state why we felt them.

The recent reasonable and even necessary outcry for popular scientific education in this country has led to the publication of a perfect shoal of elementary treatises. Everyone who has a smattering of knowledge or who has access to a consulting library considers himself thereby fitted to write a treatise. For one such that is written by a man thoroughly competent as far as knowledge and experience can qualify him, we have half a dozen written by popular lecturers, or rather showmen, in whose eyes sensational experiments sensationally described form the really attractive portion of science! Besides these, we have a dozen others—some the work of those fluent writers who can master a new subject in a week, complete an octavo treatise on it by the end of the month, see it through the press, and proceed immediately to repeat the process on something newer still; the others, the original work of uninstructed but aspiring men, who have learnt too little to be aware either of what science is or of their own utter ignorance of it. This is no fancy sketch, but, as all competent to judge will allow, an exceedingly unpleasant reality. In some subjects, no doubt, competent men have the field (as yet) left almost to themselves. It is only now and then that an ignoramus ventures to produce a treatise on Hyperdeterminants, Vortex Motion, or Specific Inductive Capacity. Yet, if books on such subjects could command a host of eager *and ignorant* purchasers, there would soon be a supply from quarters hitherto undreamt of. But anyone and everyone can write on such simple matters as heat, light, electricity, or (more to our present purpose) sound and music. "Bother Helmholtz, and Clerk-Maxwell, and Thomson," cries a public athirst for sensation, and whose palate is already dead to all but the most potent spices; "we want excitement, knowledge too if it comes painlessly, but excitement;" which (viz. the sensation and the excitement) are precisely what that same public will *not* get from Mr. Taylor's work. Not once, in the whole course of his 219 pages, has he condescended to cater for the mere amusement of his reader. We hope, but almost against hope, that this will not interfere with the sale of his book.

The book, with the exception of a few slight blemishes, to some of which we will presently advert, is a very good one indeed: lucid, comprehensive, and accurate. Many of the more difficult ideas introduced are illustrated very happily by analogy; and, so far as the first half of the volume is concerned, there is nothing which should present a difficulty to any reader of average intelligence. It is necessarily otherwise with the second half, which treats mainly of music, for this is a subject which mere intelligence, however acute, will not enable a man to master. One may as well discourse of colours to the congenitally blind, as of music to a man devoid of "ear." It has often struck us as one of the most remarkable of phenomena in the physical world, that while we ourselves were only greatly annoyed by the discordant grinding of some street-organ miscreant, one friend beside us has been almost in a state of frenzy, while another, on the contrary, listened with the most stolid indifference. [We leave it to the psychologists to consider whether the mind itself may not, in certain individuals, have similar excess or defect in some particular quality, and if so, to explain by it the existence alike of sceptics and of fanatics.] Considering that this extraordinary difference is often found to exist between individuals nearly related, and in all other particulars closely resembling one another, it is not to be wondered at that even among those who possess in a special manner an ear for music, individuals should be found to differ widely from one another on many of the less important points. In such a case who is to decide? *Cæteris paribus*, we should be inclined to side with the mathematician, who has, as it were, an extra sense in addition to those possessed by his antagonist. Wherever, then, we find that Mr. Taylor's view is not exactly in accordance with that of Helmholtz (though the discrepancies, so far as we venture to think we understand them, are few, and, with one exception, of apparently small importance), we are inclined to take the side of Helmholtz. But, we repeat, this is not to be considered as a demerit of Mr. Taylor, for the main point of variance (if we be correct in supposing it to exist) seems to be an æsthetic one, upon which only a comparatively small number of persons (and these not only exceptionally gifted, but also highly trained) are competent to form an opinion. We outsiders may judge of the value of such opinions by comparing the verdicts of different art critics on the same picture; though in the case of sound, where the physical processes (in the external ear at least) are thoroughly known to the mathematician, he ought to have a decided advantage over those who have not his physical insight. The following passage (§ 75), seems particularly happy:—

> "That *two sounds should produce absolute silence* seems, at first sight, as absurd as that two loaves should be equivalent to no bread. This is, however, only because we are accustomed to think of sound as something with an external objective existence; not as consisting merely in a state of motion of certain air-particles, and therefore liable, on the application of an opposite system of equal forces, to be absolutely annihilated."

There is, however, considerable objection to be taken to the word *forces*. Had Mr. Taylor said *motions*, or still better *disturbances*, the passage would have been not only clearer but more correct.

A closely-connected mistake occurs, in two different forms, in §§ 22, 50. In the former, the word *force* is used in place of *energy*; in the latter, *energy* is used where *force* is obviously the correct word. But here, though in all probability unconsciously, Mr. Taylor is only following the metaphysicians and other quasi-scientific men, who give what they call a "broad basis" to the meaning of a word by using it now in one sense and anon in quite a different one.

Another curious statement, occurring in § 8 and repeated in § 37, seems to show that Mr. Taylor's clock has a half-second pendulum, for he speaks of a *complete* oscillation (from side to side and back again) as taking place in one second!

The inherent defect of all non-mathematical treatment of a subject undoubtedly mathematical shows itself in the elaborateness of Mr. Taylor's explanation of wave-motion. We are quite sure that a very slight amount of the most elementary geometry, properly introduced, would have enabled him to condense the whole of this part of his work into one-third of its present bulk or even less, and this with a decided increase of simplicity and intelligibility to the ordinary reader.

We object entirely to the word *strictly* in the foot-note to § 5, for, instead of being *not strictly accurate*, the statement referred to is not even approximately accurate. In the same section there is an illustration of wave propagation by the alternate kneeling and standing of the individuals of a line of men, where the reader is likely to be much puzzled by the printing of "two, six, and nine," instead of "twenty, sixty, and ninety." This, however, may be called hypercriticism, so we proceed to point out that in § 23 there is a genuine blunder. Mr. Taylor says that in the diminution of loudness and dying away of the sound of a pianoforte wire once struck, "the effect produced is the same as if our harmonium had, while sounding out its note, been carried gradually further and further away from us," forgetting altogether what, indeed, we do not find in his book, the lowering of pitch which accompanies diminution of intensity when the source of sound moves away from the observer.

In § 54 the word *submission* (subdivision ?) produces a curious effect, due probably to the printer.

We conclude by repeating that the work is a very good one, worthy of the subject; and that we are glad to see that (in default of an English translation of the "Tonempfindungen") the beautiful discoveries of Helmholtz have found in this country an able and congenial expositor. Had we thought less of the work we should not have been driven to criticism of mere isolated words or phrases which easily escape detection by an author himself. Yet, *after* all, we must conclude with an expression of amazement that a man who shows himself to have so thorough an appreciation of harmony as does Mr. Taylor, should tolerate for a moment in his pages a foreign word such as *timbre*, when we have an excellent and generally received English equivalent for it; or employ for a concord such a hideously inappropriate word as the English *clang*.

MAREY'S "ANIMAL MECHANISM"

Animal Mechanism. By E. J. Marey. "The International Scientific Series." (London: Henry S. King and Co., 1874.)

I.

ON more than one occasion during the last year or so, we have drawn attention to a small French physiological treatise by Prof. Marey, entitled "La Machine Animale." It is not only to a passage here and a passage there that we have had to refer, but to the thorough exposition of intricate problems of mechanical physiology, which have been worked out with a degree of ability rarely to be found in a single author. It is a translation of thi work which forms the subject of the present review.

Prof. Marey divides his subject into three parts: th first devoted to general principles; the second to terrestrial locomotion; and the third to aërial locomotion. I is to the last two of these that we wish to draw attentio both in this and the succeeding notice.

Terrestrial locomotion comprises that of bipeds an that of quadrupeds: man and the horse, exemplifyin them respectively in their most complicated forms, serv as excellent examples. Human locomotion is a subjec which admits of more scientific treatment than might first sight be supposed. There is no better proof of this than the fact that until Prof. Marey quite recently disproved it, the theory of the brothers Weber was generally accepted, namely, that the non-supporting leg moves pendulum-like in walking.

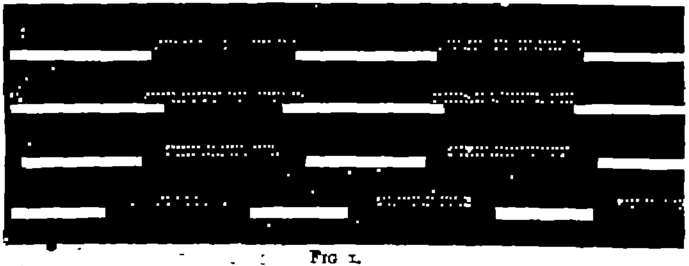


FIG. 1.

Whilst, with the mind otherwise unoccupied, anyone sets to work to study the different movements of his legs in hopping, jumping, walking, and running, there are many points that he can make out without further assistance, such as the fact that in walking the feet are never both off the ground together, whilst in running the body is unsupported between each two steps. Our author and one of his pupils, M. G. Carlet, have, however, succeeded in putting down the results of their carefully conducted experiments in a form which allows of their being studied by others as well as by the subjects of the experiments themselves. By means of elastic air-bag with connecting tubes they have transferred the movements they discuss to paper, and have had these tracing copied as woodcuts.

After having proved that the intensity of the pressur of the foot upon the ground is not solely dependent on th weight of the body, it being greater at the end of th step than at its commencement on account of the muscular effort then added, Prof. Marey describes th vertical and horizontal movements of the body in walking, and shows that the former oscillations are twice a numerous as the latter. This can be verified by observation; at all events, the rise of the body can be seen t be as rapid as each step, whilst the slowness of "th waddle" is proverbial. Next, the greater pressure at th end of each step is proved, by a very ingenious contrivance, to increase the forward movement of the body during that time, and to be least at the moment when the foot reaches the ground.

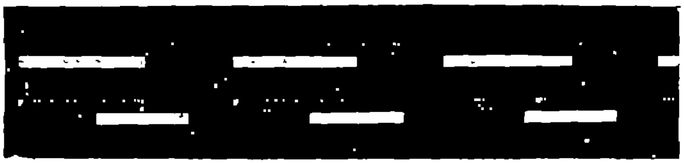


FIG. 2.

In describing the rhythm of the different modes of progression adopted by man, the tracings obtained by the recording instrument are transcribed into a notation which is a modification of that employed in music. Two horizontal lines form the staff on which this simple music, consisting of only two notes, is written. A broad white line expresses by its length the duration of the pressure of the right foot; a similar shaded line does the same for the left; any interval between the two indicates the time during which the body is suspended above the ground. On this method the diagram in Fig. 1 will represent the *formula* of the rhythm of the walking pace (1), of ascending a staircase (2), o running (3), and of rapid running (4). From these it ma be gathered that in walking the contact of one foot wit the ground follows that of its fellow without any interval that in climbing a hill or going upstairs there is thi difference, namely, that the one foot does not leave th ground until its fellow has been in contact with it a perceptible time; that in running there is an interval at eac step during which the body is quite off the ground; and fourthly, that in rapid running, though the duration o each step is shortened, that of the interval is lengthened.

Fig. 2 represents the gallop of children, (1) being what may be termed left gallop, and (2) right gallop, according to which foot is in front. This rhythm will be found instructive when we come to refer to the same in the horse.

The upper of the two portions of Fig. 3 represents a series of leaps with the feet together, whilst the lower is the notation of the hop on the right leg, in which, from fatigue, the duration of the time of contact with the ground increases; it will be observed that the time of suspension, nevertheless, does not vary. All these diagrams are so instructive in themselves that they need no further detailed explanation.

Fig. 4 will give an idea of the instrument employed in studying the complicated problem of quadrupedal action, in which it will be seen that the movements of each foot communicate, through elastic tubes, movements to the levers of the recording apparatus held in the hand of the rider. In interpreting the tracings thus obtained into the musical notation above employed to describe the different rhythms of human progression, the only thing necessary is to introduce a second pair of bars below that previously employed, to represent the hind feet. A diagram like Fig. 1 is the result. Before the introduction of this graphic method, the action of the horse, which used to be an endless subject of dispute, was made out from the imprint of the shoe-marks left in soft ground; this, however, varies for any given action with the rapidity of movement and the size of the animal which forms the subject of experiment.

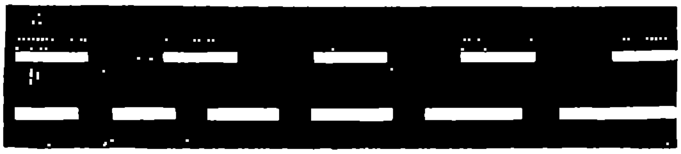


FIG. 3

As we explained not long ago (NATURE, vol. x. p. 39), according to the work before us, the action of the horse in walking, we need not discuss that step on the present occasion. It is by far the most complicated of the movements. The trot is much more simple, being a double instead of a quadruple action; the opposite fore and hind feet striking the ground simultaneously. There is also an "irregular trot," which is frequently met with, and depends on a lag in the action of the hind limbs.

"Several different paces, the common character of which is that irregular impacts return at regular intervals, are comprehended under the gallop." There is the gallop in *two, three,* and *four* times, so called according to the number of sounds heard in each completed pace Fig. 5 gives the notation of the gallop in three-time, which is the most common; *A* indicating the time, and *B* indicating the number of feet which support the body at each instant of the step. From it the left hind-foot is seen to reach the ground before any of the others, and to produce the first sound: the second is caused by the simultaneous impact of the right hind and left fore feet; and the third by the right fore-foot, which the animal always places forward to commence with. The similarity between this pace and that of children "playing at horses" can be readily seen by comparing this figure with Fig. 2. The gallop in four-time differs from that just described, in that the impacts of the hind legs are slightly delayed, which causes the two feet, which in three-time strike the ground simultaneously, to do so one after the other, the right hind one after the left fore, so that the single sound is duplicated.

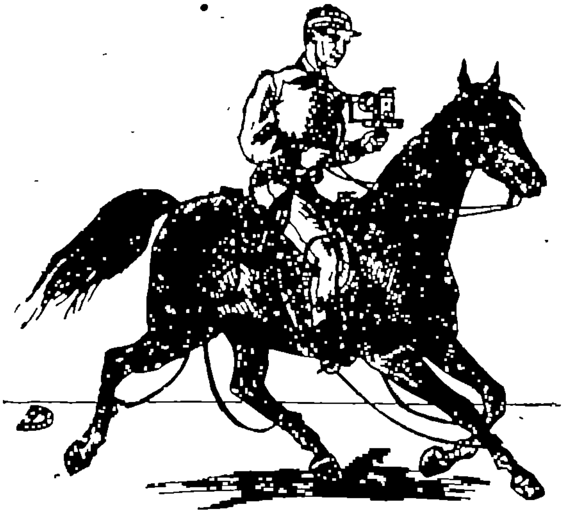


FIG 4.

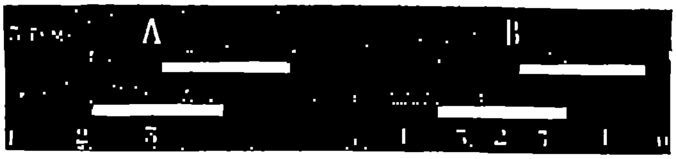


FIG 5.

The full gallop is so violent an action that the delicate instruments employed in analysing the previous movements have to be dispensed with, and a more substantial apparatus employed. The rider, instead of carrying it in his hand, has it tied, as a knapsack, on his back, and he sets the recording watchwork in motion with his teeth. Notwithstanding the difficulties of the experiment, very successful tracings have been obtained, which show that the full gallop is really a gallop in four-time, in which, although the fore-feet hit the ground with a fair interval, the hind feet hit it nearly simultaneously. The time of complete suspension is extremely short.

Besides the actual and relative durations of the different paces, Prof. Marey's instruments are so constructed as to record also the rise and fall of the body of the horse during each. This point is of particular interest, as it explains the varying degrees of comfort to the rider in the trot, gallop, &c. The rise in the trot is sudden and simultaneous with the time the animal's feet are on the ground, and the fall with the time of suspension. In the gallop the same is the case, though the rises and falls are less sudden; they are, "therefore, less jarring to the rider, though they may, in fact, present a greater amplitude."

(*To be continued.*)

OUR BOOK SHELF

1.—*Les Roches; Descriptions de leurs Éléments: Méthode de Détermination, etc.* Par Edouard Jannetaz, Docteur ès Sciences, etc. (Paris: J. Rothschild, 1874.)

2.—*Les Minéraux: Guide Pratique pour leur Détermination, etc.* Par F. de Kobell. Avant-propos et Additions, par F. Pisani, Professeur de Chimie et de Minéralogie. (Same publisher.)

3.—*Le Monde Microscopique des Eaux.* Par Jules Girard. (Same publisher.)

THESE three works form part of a series of popular scientific treatises issued by the enterprising Paris publisher, M. Rothschild. They are small volumes neatly printed and got up, and Nos. 1 and 3 are fully illustrated with well-executed cuts.

No. 1 is intended as a practical guide for the use of engineers, geologists, mineralogists, agriculturists, and pupils of Government schools. It is illustrated with thirty-nine woodcuts, contains a great deal of valuable information in small space, and seems well calculated to form a useful little handbook for the classes mentioned.

No. 2, which is a translation from the tenth German edition of Kobell's work by Count L. de la Tour-du-Pin, with a preface and additions by Prof. Pisani, is intended for the use of chemists, engineers, manufacturers, &c., and, like the above, seems well calculated to serve its purpose, of helping those who have a moderate knowledge of chemistry to analyse speedily and exactly the principal minerals.

No. 3 is of a much more popular kind than the two previously mentioned works; its author, M. Girard, is well known as a successful populariser of scientific results. It contains sixty-eight beautiful and useful cuts. It is intended as a handbook to those who wish to derive amusement and instruction from the use of the microscope, and takes up successively some of the principal points in the animal, vegetable (existing and fossil), and mineral kingdoms.

Nos. 1 and 2 have very full indexes appended.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Periodicity of Auroras

ON my return to Newcastle-on-Tyne I take the opportunity of being able to recur to books of reference to reply to a question put by Mr. Procter, in NATURE (vol. x. p. 355), whether any complete catalogues of auroras have been constructed, and if they show indications of periodicity in its displays. Kæmtz's "Meteorology," in which almost every feature of the weather capable of being chronicled has been fully catalogued, probably contains a list more or less complete, up to its author's time, of all then known descriptions of auroras. If this be so, it has probably served for the groundwork upon which later and more complete catalogues have been compiled, extended, and completed in his own and other countries. Dr. Heis, the director of the Prussian Observatory at Münster, in Westphalia, is especially active in collecting information of the slightest appearances of aurora in any quarters of the globe, from whence published or private descriptions of them can be obtained. Every successive number of such works as Mr. G. J. Symons's *Monthly Meteorological Magazine* and the *Quarterly Journal of the Scottish Meteorological Society* contains, in a few pages of "meteorological notes" on the weather peculiarities of each month from their numerous observers, a list of scattered aurora-observations, which is probably as complete for the British Isles during the years in which these publications have been carried on, as the perfect or partial clearness of the sky over this country, and indeed over some adjacent continental stations, enables such a list to be made by observations. But this collection, invaluable as it is for our own immediate field of registry, is not assorted, nor suited, without extension by the help of similar collections made in surrounding foreign countries, to be regarded as a sufficiently extensive list of auroras for dealing generally with the question of their periodicity. The present state of progress of our knowledge, with regard to auroral frequency, we owe largely, if not almost entirely, to the researches of Prof. E. Loomis, of Yale College, U.S., the results of whose discussion of the collateral views and considerations involved in them will be found in numbers of the *American Journal of Science* for July 1860, Sept. 1870, and April 1873. In the first of these papers, a map of lines of equal auroral frequency for the northern hemisphere is presented, dividing the northern area of the globe into zones encircling the arctic regions. It appears, for example, from this map, that auroral displays are not very much more frequently visible in St. Petersburg than they are in London, and that even Boston and Edinburgh are as frequently visited by them as the great northern capital itself. An oval belt of greatest auroral frequency encloses together the north geographical and north magnetic poles, covering all the European, Asiatic, and American coast lines of the Arctic Ocean, and passing onwards from the latter across Hudson's Bay, the mouth of Baffin's Bay, and Iceland, back to the North Cape. For a short distance within this ample belt auroras continue to be tolerably frequent, and grow comparatively more scarce in Smith's Sound and the northern parts of Baffin's Bay, and indeed apparently in proportion as the geographical north polar regions are approached.* It is with the outer and not with the inner margin, however, of this ring-maximum of auroras that observers in ordinary latitudes are concerned, and it is pointed out in his most recent paper by Prof. Loomis, that in constructing general catalogues for deciding questions of auroral periodicity, a line, or at least a restricted zone, bordered northwards and southwards by lines of equal auroral frequency, should be chosen as the localities from which observations may be gathered. To place this line or belt in the zone itself of almost constant auroral activity, where auroras can only vary periodically in brightness rather than in

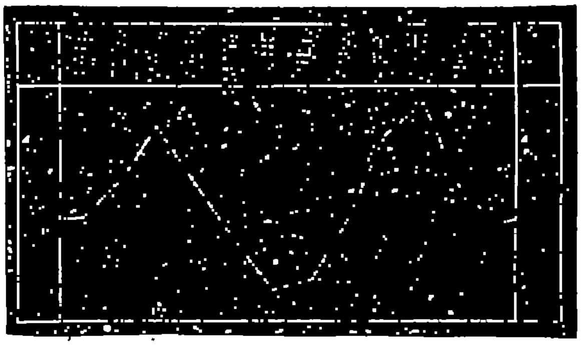


FIG. 1.—Number of auroras observed in each month of the year (Kæmtz)

frequency, would be of no avail for enumerations; the zone selected must be one of occasional auroras, arising only from the southward spreading of the strongest disturbances of the ever-beaming and sometimes forth-sallying illuminations of the north.

---

* It will be remembered that in Capt. Kane's description of a winter-detention of his vessel in Smith's Sound (the northernmost passage from Baffin's Bay, about eight and-a-half degrees from the north pole), it is related that the feeling of prolonged darkness at length became so oppressive that even the Esquimaux dogs were affected by it, and when excluded from the luxury whined piteously for light. A darkness so deep and enduring as this description suggests can scarcely have been broken, as it occurs in the more favoured belt twenty degrees south of this high latitude, at the mouth of Davis Strait, by the illumination of bright rays and flashing beams of constantly appearing fine auroras. The position occupied by Capt. Kane was not more than two or three degrees from the general centre of the region of fast-diminishing auroral frequency, embracing the whole Arctic Ocean, which is shown on Prof. Loomis's auroral map as merging insensibly on all sides into the broad or narrow belt of greatest auroral activity surrounding it. The latter seems to follow very nearly along its whole extent, with a corresponding strong depression and expansion of its width towards Hudson's Bay, the general direction of the arctic coast-line.

It is also for such other obvious reasons, as that years of arctic exploration tend to appear in general catalogues as years of extraordinary auroral frequency, and that observations in Asia, Western America, and in the whole of the southern hemisphere have for the most part been made but recently or at very irregular intervals, that the use of general auroral catalogues in questions of periodicity calls for much selection and reduction of the miscellaneous mass of observations. A most extensive general auroral catalogue appears to have been published early last year, or at the end of the previous year,* by Prof. Lovering, of the United States, of which Prof. Loomis has employed the materials, and of which he acknowledges the completeness in terms of commendation. It extends from the year 500 B.C. to the year 1864, and includes with its supplements upwards of 12,000 cases of observed auroras. For the following years, from 1864 to the end of 1872, Prof. Loomis has continued the catalogue for a restricted area suited to the question of periodicity, partly from American sources, and partly (in Europe) from the periodical journal published by Dr. Hess, *Wochenschrift für Astronomie und Meteorologie*. The selected region of observation is limited on the north by an iso-auroral line skirting the northern boundary of the State of Massachusetts and crossing the Atlantic from near Boston to the north of Ireland, passing thence between England and Scotland, and through the northern part of Jutland, a little south of Stockholm, to a little north of St. Petersburg, where it continues its course in Russia as far as long. 40° E. from Greenwich. The meridian of this longitude (nearly that of the eastern ends of the Black Sea and Red Sea) limits the area on the east. It is similarly limited westwards by the meridian of 80° W. from Greenwich, including Washington, and the eastern, but none of the western States of North America. A lengthy general catalogue for this region was extracted by Prof. Loomis from Lovering's list, including all the auroras recorded in it in the years between the beginning of the year 1776 and the end of the year 1872, with their month and dates. The whole of this long list, supplemented in great measure by his own inquiries, is given at full length at the end of the last paper (*sup. cit.*) by Prof. Loomis. The number of auroras in each year, or their annual frequency, is then obtained and laid down in a curve for the whole interval of ninety-six years of the observations. On the same plate is projected the mean daily range of magnetic declination, and the relative extent of black spots on the sun's disc for the same series of years of observation; the latter from Wolff's numbers, and the former from the average of magnetic observations made at Prague from the year 1777 to the year 1871 inclusive. Very uncouth in appearance are all these curves: and the curve of annual auroral frequency is far the most shapeless in outline of them all; but the leading crests and troughs of the ruling eleven-year period of the sun-spot curve are conspicuously reproduced in each of the other two curves, so that it is difficult to say whether the auroral curve or the curve of magnetic declination is the stricter in its adherence to the times of maxima prescribed to it by the solar spots. In two cases, however, the auroral maximum took place some three years, and in another case about a year, too late (1840, 1851, 1871). The maximum of the magnetic disturbance curve also took place on one of these occasions (1838) a year later than the sun-spot maximum, while in the year 1787 both the auroral frequency and magnetic disturbance curves attained their maxima together between one and two years earlier than the sun-spot curve.

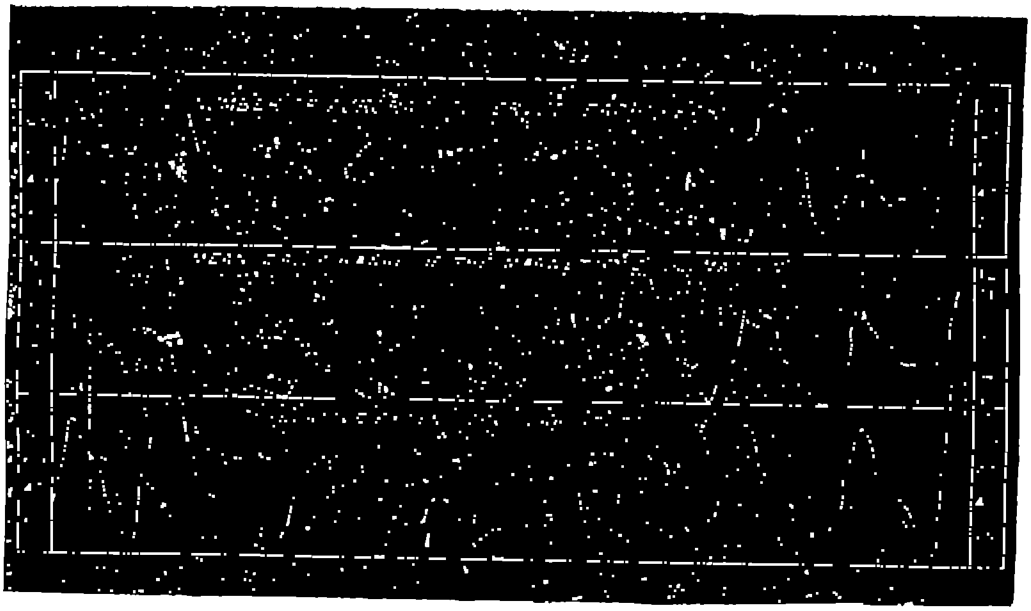


Fig. 2

Prof. Loomis concludes that the times of auroral minimum and maximum frequency happen on an average from half a year to a year later than the same critical times of magnetic disturbance and of the sun's relative obscuration by black spots; that they are more nearly related to the same times for the magnetic daily range than for the sun-spot curve, and that the time of greatest auroral frequency lasts longer than that of the sun's obscuration by spots or of the magnetic needle's greatest daily disturbances. A period of very moderate activity in all the curves is embraced between the maxima of 1788 and 1830, which is particularly noticeable in the scarcity of auroras and in the smallness of the magnetic oscillations in that period. More than 4,000 auroras are included even in the limited selection from Prof. Lovering's catalogue used by Prof. Loomis to establish these results, and yet the interval of ninety-six years (during which the magnetic declination had been continuously observed) to which it is confined proves to be too short to determine certainly the long cycle of activity and repose that seems to govern the times of greatest auroral frequency for years together, in long recurring periods of between half a century and a century. In a previous paper (the second in the *American Journal of Science* above quoted), Prof. Loomis had arrived at all the conclusions of the paper just described from an auroral catalogue of his own construction, of observations in not very northerly latitudes of Europe and in the United States; extending, however, only to the year 1850, the closing year of the magnetical observations at Prague then accessible to him. A period of about sixty years, from the maximum of the year 1790 to that of 1850, was thence concluded, perhaps too confidently, as the real length of this long cycle of auroral frequency.

---

* "Memoirs of the American Academy," vol. x.

On turning to Kæmtz's "Meteorology" (translation by C. V. Walker, 1848, p. 458), I find that the author, with his usual exhaustive completeness, has constructed a general list of auroras observed up to his time (about the year 1820), and has established from it certain laws of their periodicity. The list itself, although not given for brevity in the translation, is in all probability contained in the original, and it must embrace upwards of 3,000 cases of auroral occurrences, since a table of about that total sum showing the numbers recorded in each of the several months of the year is given as the most important scientific result of the compilation. The numbers seen in March, September, and October are about half as great again as those recorded in any of the adjacent months, and about twice as great as have been recorded in either of the two mid-winter months of December and January, when the length of the nights is yet most favourable for their registry. That the numbers of auroral displays noted in June and July are relatively very small is easily explained by the length of the twilight in those months in European latitudes, rendering many, that would be conspicuous exhibitions in darker nights, invisible.

The times of greatest annual activity of the auroræ are thus about the seasons of the equinoxes, when the seat of the most direct action of the sun's rays upon the earth's surface is undergoing its most rapid changes during the sun's yearly course; and when nearly the same parts of the earth's surface continue to be heated directly by the sun's rays at the seasons of the winter and summer solstices, there are times of comparative repose and tranquillity among the exhibitions of auroral outbreaks.

Regarding a secular period, Kæmtz's Catalogue appears to have shown nothing positive. "A period of this kind," he writes, "occurred between the years 1707 and 1790, attaining its maximum about the year 1752; since the year 1820 they have again continued to become more numerous." This maximum in the year 1752, and those shown on Prof Loomis' auroral curve about the years 1780–90, 1850, and 1870–72, agree very ill with each other, or with the return of a constant cycle of long period connecting them together; the succession more nearly resembles that of periods of hot summers, or of cold winters, governed by fixed laws that have not yet been discovered in their returns and durations: and seems to point to causes influencing the production of auroras very similar to those which determine some of the obscurest features of our seasons. Thus, since the commencement of the earliest continuous temperature-records at the Royal Observatory, Greenwich, in the year 1771, the commencement of winter or the arrival of a mean daily temperature of 40° has fluctuated between the months of November and December, apparently from different degrees of prevalence in those months of an annual tide of south-west wind then reaching a maximum in the British Isles. Assuming changes in the strength of this wind to be the cause of the observed fluctuations and of a gradually increasing retardation of winter and secular rise of mean temperature in the months of November, December, and January, noticed by Mr. Glaisher during the first half of the present century, the average course of this phenomenon, when submitted to examination, resembles very closely the general course of the curve of auroral frequency. There was a sensible retardation of the winter season from about the year 1775 to about the year 1790, followed by a marked acceleration from the latter year onwards through nearly the first quarter of the present century, indicating apparently a considerable abatement of south-west, anti-trade, or equatorial currents, on an average, for that lengthened period. The acting cause however returned, and its strength may be gathered from the fact that the mean temperature of the month of December at Greenwich during the twenty-five years from 1825 to 1850 was higher in eight years than that of the month of November, an anomaly which had only taken place thrice in the first quarter of the century. The last occurrences of the same kind, with which I am acquainted, happened in the years 1858, 1861, and 1862; but the strong retardations of winter, noticeable towards the year 1850, were then rapidly disappearing, and it is not improbable that in the further fluctuations that have since followed, a new correspondence between the secular rise of temperature of the months of November, December, and January at Greenwich, and the considerable maximum of auroral intensity reached during the years 1870–1873, may be found to bear out an analogy which is only hazarded here, in the absence of a better working hypothesis, as an apparently real and perhaps not altogether unnatural connection.

With regard to the relative proportion between eastward and westward movements of auroral rays, I know of no observations that have been made that can offer Mr. Procter any additional information. The possibility that auroral streamers may be uprushes of positive or negative electricity to a point of saturation in the highest regions of the atmosphere, followed by downrushes of the same electricity when the exciting cause in the interior or on the surface of the globe subsides, might be well proved by such observations. The existence of the motion shows that the auroral rays diverge sensibly from the earth's lines of magnetic force, probably in the endeavour (whether effectual or not is indifferent to the explanation) of the Aurora Borealis and Aurora Australis to combine and to neutralise each other (perhaps a rare occurrence) across the equator. The strength of the motion of the beams may be some measure of this tendency, and its absence a sign that the aurora is local and of comparatively little generality and extent. It may here be remarked that the annual periodicity of auroras differs entirely from that observed in the average frequency of sporadic shooting stars, which reaches a maximum in August and September, but has a well-marked minimum in March, resembling the single cold of winter and the single heat of summer produced three months earlier, in each year, by the tropical motion of the sun. A marked frequency of auroras on the dates of January 1–3, April 19–21, August 9–11, October 18–21, November 14 and 27, and December 10–12, when meteor-showers of various degrees of brightness are of almost annual occurrence, has not, as far as I am aware, been definitely traced and established; but the large auroral catalogues recently published by Prof. Loomis and Prof. Lovering will, it is evident, supply very valuable materials by which any such connection between auroras and periodical meteor-showers, if it exists, can be more thoroughly investigated and determined.

A. S. HERSCHEL

Automatism of Animals

YOUR correspondent, Mr. Wetterhan, has, I think, misunderstood Prof. Huxley's argument; which is, not that the adjusted motions he refers to never were the result of conscious and voluntary motion, but that they are not so now. His letter has, however, induced me to call attention to what has always seemed to me a real difficulty. As I understand automatic or reflex actions, they are those which have been so constantly repeated and which are so essential to the well-being of the individual, that the various nerves implicated have become so perfectly co-ordinated that the appropriate stimulus sets the whole machinery in motion without any conscious or voluntary action on the part of the individual. Thus we can quite understand how a paralysed limb would be drawn up when the sole of the foot is tickled or the toe pricked. If, however, any such irritation continues to be felt in the normal state, a man would stoop down and remove the irritating substance with his hand, or would place his foot upon the opposite knee, and, stooping down, endeavour to *see* the object which caused the irritation. But these are *conscious*, not *reflex*, acts. They are not repeated often enough, and are not sufficiently identical in form, to become automatic; and we are not told that a wholly paralysed human body does actually go through these various motions, as it certainly would do if not paralysed.

Now, in the case of the frog I can quite understand the jumping, swallowing, swimming, and even the balancing; for all these are actions so essential to the animal's existence, and so often repeated during life, as to have become automatic. So, also, I can understand the drawing up of the foot to remove an irritation on the side of the body, for with the short-necked frog this too is an essential, and must have been an oft-repeated action. But we are further told that "if you hold down the limb so that the frog cannot use it, he will, by and by, take the limb of the other side and turn it across the body, and use it for the same rubbing process." Now, this seems to me not to be explicable by automatic or reflex action, because it cannot have been an action frequently if ever performed during the life of every frog. It is true that from the co-ordination of the movements of the opposite limbs, we might expect, if the irritation were continued, and the leg on the same side kept for some time in motion, that the other leg would begin to move *in the same way*. But what causes it to move in a quite different and unusual way, *across* the body to the opposite side; and this, as related, at once and without first trying its own side? The most usual motion of both legs is directly up and down, each on its own side. What is it that causes one of these legs, when it begins to move, not to move in the usual way (that which *is* automatic during life), but in an unusual manner, which must have been very rarely, if at all, used during life, and when used must have been purely conscious and voluntary? I think I cannot be mistaken in considering this to require some explanation. It may be that the frog is constantly, during life, crossing one foot over to rub the opposite side of the body; but we cannot accept this as an explanation unless it has been observed to be a fact. What puzzles me is, that Prof. Huxley, Dr. Carpenter, and Mr. Darwin, all refer to this case as an example of reflex action, and none of them see any difficulty in it, or seem to think that it requires any more explanation than the remaining quite intelligible cases. As others may, like myself, feel the difficulty I have endeavoured to point out, I hope some of your physiological correspondents will enlighten us if they can.

ALFRED R. WALLACE

Supernumerary Rainbow

IN Mr. Backhouse's letter (NATURE, vol. x. p. 437) he remarks that the supernumerary rainbow is commonly seen only in the upper part of the arch. Dr. Thomas Young, in his Bakerian Lecture ("Works," vol. i. p. 185, or Phil. Trans. 1804), after explaining the supernumerary bow by interferences, quotes a paper in vol. xxxii. of the Phil. Trans., in which Dr. Langwith describes his observation of a supernumerary bow on August 21, 1722; then remarks: "I have never observed these inner orders of colours in the lower parts of the rainbow. I have taken notice of this so often that I can hardly look upon it as accidental; and if it should prove true in general, it will bring the disquisition into a narrow compass; for it will show that this effect depends upon some property which the drops retain whilst they are in the upper part of the air, but lose as they come lower and are more mixed with one another." But I am not aware that anyone has ever remarked an appearance which struck me on seeing a few days ago a very complete primary and secondary bow with a portion of two supernumerary bows within the primary and about the highest part of the arch. To my eye the supernumerary bows were *not concentric* with the primary. My son agreed with me as to this appearance when I pointed it out to him; yet I thought it was probably an illusion till the following explanation occurred to me.

The rain-drops may be presumed to be smaller high in the air, and to increase as they descend.

Now, the smaller drops produce wider interference fringes than the larger drops do. Hence the supernumerary bow is widest and therefore farthest from the primary at the top of the arch, and gets narrower and nearer to the primary as it descends the arch on each side, and "in the lower parts" ultimately fines away to nothing. According to this theory the supernumerary bow is not always concentric with the primary, nor indeed circular.

It should be observed that another reason for the interference bow being seen most frequently at the highest part of the bow is that the small drops high in the air are probably more uniform in size than the larger drops lower down.

Oct. 8 JOSEPH BLACKBURN

Colour in Flowers not due to Insects

THE doctrine that the conspicuous colours of flowers are entirely due to the necessity for cross-fertilisation by the agency of insects seems to be taking the world by storm. It is supported by Mr. Darwin and Sir John Lubbock. It could scarcely be put forward on better authority. Yet there are several facts with which it does not harmonise. For instance—

1. *Cultivation* increases the size and colour of flowers quite independently of the existence or non-existence of insects.

2. *Double flowers* in which the doubling arises from metamorphosis of stamens or pistils are more showy than the single forms, yet insects can be of little use to them, since they are either partially or entirely barren. The double-blossomed cherry is brilliantly conspicuous, but it bears no fruit.

3. Such *abortive flowers* as the cultivated Guelder Rose and Hydrangea depend for their beauty upon the destruction of the reproductive organs. If their increased splendour is meant only as a lure to insects, it is surely an absurd failure.

4. The *autumn colours* of leaves and fruits can serve no such purpose, yet these are often as bright and conspicuous as the flowers of summer.

5. *Fungi* and *lichens* exhibit brilliant colours, which can have nothing to do with insect-fertilisation.

Do not these facts indicate that though insects may be attracted by conspicuous colours, and may have some influence in the maintenance of coloured species, there is yet a deeper and more permanent cause for the colour itself?

Leicester, Oct. 11. F. T. MOTT

Habits of Squirrels

WOULD you permit me to ask of your readers a question or two upon the habits of squirrels? I have had one in my possession, from the age of three weeks, for more than two years. I have noticed that whenever it cleans itself, after licking, it *sneezes* violently three or four times into its forepaws, then rubs them thus damped over its fur. It seems to have the power of sneezing at volition.

Now, is this habit of sneezing, for the purpose of cleaning itself, a habit peculiar to squirrels; or is it shared by other animals?

I notice also that frequently when it is going thoroughly to clean itself it jerks its forepaws over its ears, bringing them back over its eyes, and always causing a milky liquid to suffuse the eyes. This liquid swims over the eye, and then is absorbed. I have thought that it may use this secretion also for the purpose of moisture. The animal is in perfect health and splendid condition.

A squirrel I had three years ago also had this habit, though in a slighter degree. D. T.

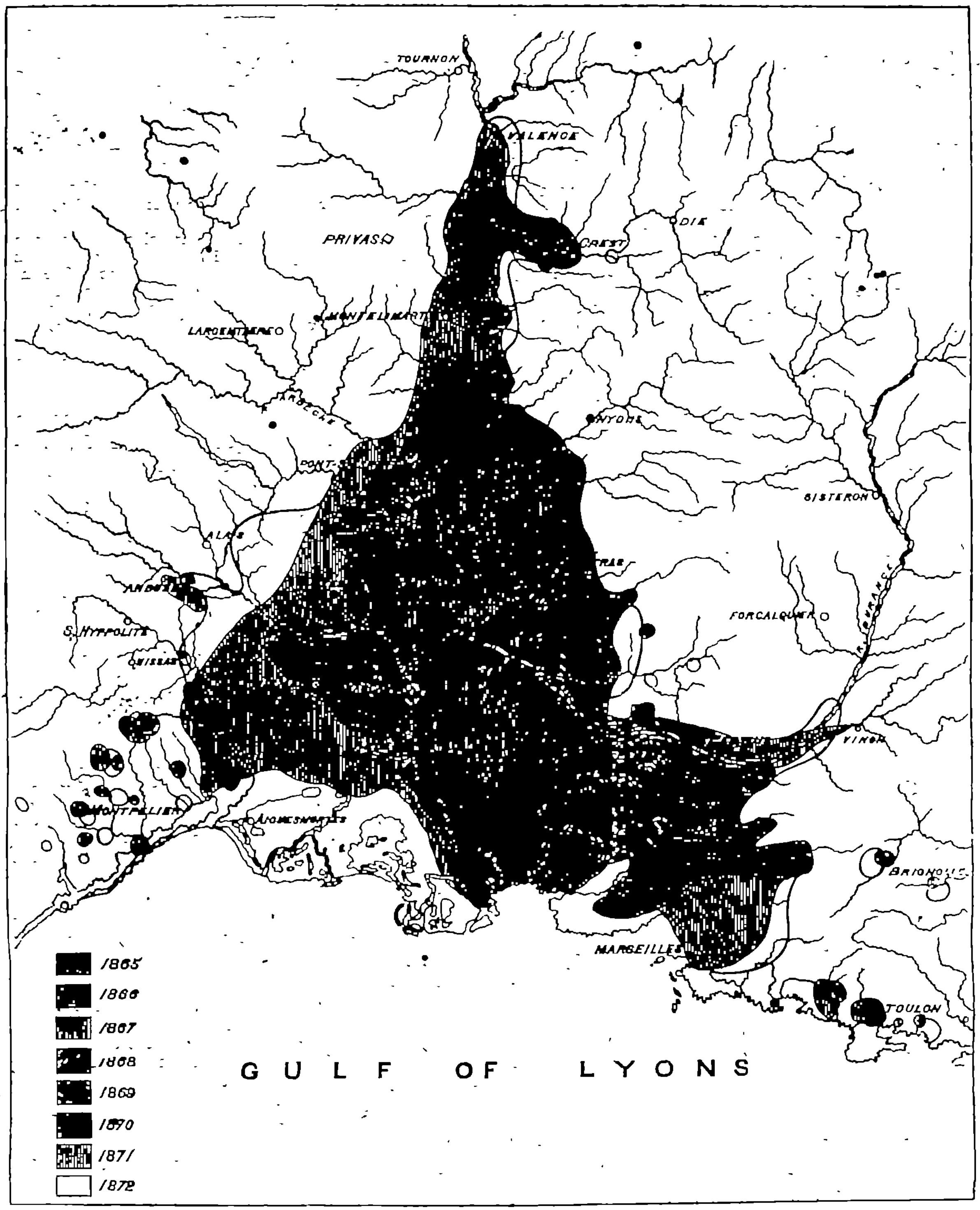
THE NEW VINE-DISEASE IN THE SOUTH-EAST OF FRANCE

I.

WE have before us the Reports presented to the French Academy of Sciences by the delegates of the Commission appointed by that body to investigate the phenomena of the new and terrible disease of the vine in the south-east of France—a disease which is fraught with the most serious consequences to the material prosperity of that country, which depends on its wine as a source of national wealth not less important than are our coal and iron to us.

It was in the autumn of the year 1871 that the Academy of Sciences directed special attention to the communications which poured in upon it from all quarters relative to the ravages of the new parasite of the vine in the South of France; and at the sitting on the 25th September in that year, it charged a Commission, consisting of M. Dumas as president, MM. Milne-Edwards, Duchartre, and Blanchard, to investigate the means of coping with the disease. The Commission examined with the greatest care all the manuscripts and printed monographs which were brought under its notice, and paid particular attention to the scrutiny of the leaves and the roots attacked by the *Phylloxera vastatrix* (for such is the name which has been given to the new insect), which had been sent to it from different places in France; and, with the object of giving to its labours the active direction necessary in such circumstances, it decided to confide the execution of them to three delegates, viz. MM. Balbiani, Max Cornu, and Duclaux, whose learned researches in zoology, botany, and chemistry, suggested recourse to them, and they were accordingly charged with the pursuit of all the observations which the subject would allow of, on the actually affected territory.

It is worth our while, at the outset, to observe the thorough and methodical manner in which an attempt has been made to wrestle with this new enemy of the material welfare of France, and the application of the resources of science to unravel as exhaustively as possible the causes and manner of extension of the invasion of the parasite from its first appearance till the present time. We in England are too apt in similar crises to neglect the practical employment of scientific means, to depend on private and individual exertions for the investigation and treatment of the different causes which threaten the national wealth or prosperity; and though in the long run perhaps we come out of the difficulty in a manner not altogether unsatisfactory, still such result can only be obtained at the expense of interests to which speedy action and prompt methodical treatment are the only means of preservation. But in France and in most of the continental countries of Europe, the State, or at least important corporate bodies, come quickly to the aid of science, which, thus subsidised and encouraged, can penetrate far deeper and can have a freer play for its researches. As a result, in the present case we have the studies of men of science on this subject of altogether national importance, studies which, if we mistake not, should go far to direct the efforts of the nation into the right course of treatment for the extirpa-



Map showing the spread of *Phylloxera* from 1865 to 1872.

tion of this alarming scourge, which has destroyed the produce of so many of the fairest vineyards of the south-east of France.

It is a matter of no difficulty to master the history of the new disease produced by the *Phylloxera*, and to trace its growth from the earliest beginnings. The first definite signs of the invasion of the parasite were observed in the year 1865, at a spot (plainly marked in the maps annexed to the report of M. Duclaux, and now copied for our readers) on the plateau of Pujaut, near Roquemaure, in the neighbourhood of Avignon, and in the department of the Gard, on the west bank of the river Rhône. Though in this year it attracted but little attention, in 1866 it descended rapidly from the plateau to the outskirts of the village of Roquemaure, and also appeared in several spots in the departments of Vaucluse and the Bouches du Rhône, both lying on the east side of the river-valley. It was the owner of a vineyard in this latter department, a M. Delorme, of Arles, who was the first to recognise the disease, while still in the birth, as a new disease, and to have the presentiment of the disasters which would follow in its train. At a later period a commission of the Society of Agriculture of the Hérault visited by request the vineyards around Saint-Rémy, and a member of that commission, M. Planchon, discovered that the cause of the vine-disease was an insect "destined to be the subject of so much discussion, and to become the source of so much misery." It was he who afterwards gave the parasite the name which it has since borne everywhere—*Phylloxera vastatrix*.

Before proceeding to describe the ravages of the insect and the manner in which it ultimately causes the death of the vine, it will be well to show the progressive extension of the disease itself over the country adjacent to the Rhône valley and lying inland to the north of the Gulf of Lyons. M. Duclaux has shown us, in his series of maps annexed to his report, the progress of the disease between the years 1865 and 1872, and marks it as gradually extending from the little spot first attacked in the neighbourhood of Avignon till in the last of those years it included the whole country between Valence on the north and Marseilles on the south, while westwards and eastwards it extended to Montpellier and Aix respectively, thus covering, roughly speaking, nearly four departments, viz., the Gard, the Drome, Vaucluse, and Bouches du Rhône. We are told in the memoir of M. Louis Faucon, also presented to the Academy of Sciences, and embracing a later period than that of M. Duclaux, that the disease extended to an alarming degree in the year 1873, at the same or a greater progressive rate, and had established itself in that year in no less than twelve departments of South-east France, having spread into the Ardèche, the Basses-Alpes, Var, Isère, Hérault, and even reaching so far as the Gironde and the two Charentes.

We may gain a more precise idea than can be afforded by a mere observation of the geographical extension of the disease, of the disastrous nature of the ravages of the *Phylloxera*, by the examination of some of the statistics of the grape-crop in successive years in some of the departments attacked. Thus, in the department of Vaucluse, where the disease showed itself in 1866, there were in 1869, according to the results obtained by the departmental commission instituted at Avignon to observe on the new vine-disease, 6,000 hectares absolutely dead or dying, and a much larger number already attacked, which have since succumbed to the parasite. Out of the 30,000 hectares of vineyard comprised in this department, 25,000, or five-sixths of the total area, have been destroyed. In the Gard, where the vine flourishes better than in the above-mentioned department, the ravages of the disease are yet most terrible, for in 1871, in the arrondissement of Uzès, but one-half of the average crop was produced, and in the arrondissement of Nismes, a tenth part of the crop was destroyed. These proportions, moreover, have increased since that year.

If we examine the mischief done in the less extended areas of the communes, we shall obtain a still clearer idea of the rapid spread of the disease:—

COMMUNE OF GRAVESON.

1865-66-67	mean crop	10,000	hectolitres
1868	"	5,500	"
1869	"	2,200	"
1870	"	400	"
1871	"	250	"
1872	"	100	"
1873	"	50	"

In the commune of Maillanne the crop in 1868 was only 40 per cent. of the average of the three preceding years, while in 1869 it was only 10 per cent. In the commune of Eyragues the crop in 1868 was about 33 per cent. of the average of the three preceding years, and in 1869 there was a further falling off of about 10 per cent. In 1870 the crop in the three above-named communes was almost entirely destroyed. From instances such as these, fairly selected from many others equally tragic in their stern figures, we may form some idea of the magnitude of the disaster. Indeed, it is difficult to see, so rapid is the extension of the disease, how, unless some potent and effective remedy can be soon applied, any vine-bearing district in France can escape the visitation of the *Phylloxera*.

Though there can be no doubt that the *Phylloxera* is the cause of the new vine-disease, this conviction was by no means arrived at at once, nor without considerable doubts being thrown upon it by those whose better judgment was obscured by the confusion of concomitant phenomena such as drought, cold, and impoverishment of the soil with the real source of malady of which they were the companions. Others, even now, hold that the *Phylloxera* is the effect and not the cause of the disease; this idea M. Faucon dissipates satisfactorily in his treatise by the following reasoning:—A vine is watched which is in a perfect state of health and vigour; not a single parasite is discovered in the ramifications of its roots. A day comes when the destructive insect invades it—it resists for some time; the *Phylloxera* lays its eggs, multiplies its numbers, and with them its attacks. The stem of the vine begins to show signs of the disease, and if the roots are laid bare, they may be observed to have deteriorated in some degree from their normal state. The multiplication of the insect continues, and assumes such proportions as to form yellow spots of no small size, the result of the close collection of a large number of the insects, whose puncturings are so numerous and so incessant that the roots can no longer perform their proper function, the nutrition of the plant, which, in consequence, falls into a most evident state of sickliness, lingers on for some time, and eventually dies. The *Phylloxera* takes its first food where it can get it with the least difficulty. After it has exhausted the surface rootlets, tender and succulent as they are, it attacks others deeper down; then it spreads over the hardier roots, till at last the prodigious increase of its family causes it to overrun the whole radical system of the plant, and even the part of the stock of the vine which is underground. It abandons the exhausted plant when it is of no more use to it, and its instinct turns its steps towards a new vine, where it can find fresh food. The work of destruction in a vine, especially if it be vigorous and the soil nutritious, is not completed in a few days. A year may pass without the vine exhibiting any marked sign of sickness. The store of vigour which it contains in itself, added to that which it imbibes for some time after it is attacked in the soil, will permit it during one or even two seasons to perform the double functions of nourishing both itself and the parasite which eventually destroys it. M.

Faucon's observations, confirmed by those of all the other persons who have made positive investigations for themselves, have established that—

1. The number of insects on a plant is in direct and constant accordance with the state of the roots.

2. According as the state of the roots is healthier, is the number of insects greater.

3. The number diminishes in proportion to the exhaustion and consequent death of the roots.

4. On an absolutely dead plant it is impossible to discover a single insect. Surely, therefore, the *Phylloxera* is the cause, and the only cause, of the vine-disease, since its appearance invariably precedes the rotting of the roots, and never follows on their decay.

We postpone till next week the description of the *Phylloxera* itself and the manner in which it attacks and ultimately kills the vine, together with the mention of the various means which have been proposed for the extirpation of the disease.

(*To be continued.*)

PHYSICS AT THE UNIVERSITY OF LONDON[*]

At the present time, when the bulk of the educated population of many countries may be divided into the three classes of *Examinandi*, *Examinati*, and *Examinatores*, a large part of any discussion of what is called the higher education must inevitably be devoted to the question of examinations. Usually, if the matter is discussed from the point of view of those whose business it is to teach, the result is the condemnation of examinations in general as unfavourable to all thorough study; and, from whatever quarter the discussion proceeds, it seems to be taken for granted that the functions of the teacher and those of the examiner are naturally opposed to each other. And indeed no one who has given any attention to the question can doubt but that such an opposition really does exist in very many cases. Originally employed by teachers themselves to consolidate and test the results of their instruction, examinations were at first a natural part of the educational system; but of late years they have rapidly developed into an independent species, which has separated off from the parent organism and now too often tyrannises over it. As of other developments, so of this, we are bound to believe that it is an adaptation to co-existing conditions, and therefore fulfils some useful purposes; but, from the teacher's point of view, as soon as examinations become detached from instruction, and come to be the end of learning instead of a means of teaching, the evils they produce are much more apparent than these benefits. When they have no worse result, they are apt to be viewed by students as affording them an authoritative standard, independent of the judgment of their professors, by which to decide what subjects of study and what parts of these subjects are of sufficient importance to be worthy of their attention. It is therefore not to be wondered at that such examinations should be looked upon by teachers with dislike, as being hindrances and not helps to their work, or that we should hear frequent protests against their excessive multiplication.

While, however, I in general heartily sympathise with such protests, and feel strongly that the difficulty of honest and thorough teaching in my own subject is greatly increased by the regulations for those examinations which, in fairness to the students attending my lectures, I am bound not to lose sight of, it does not seem to me that the remedy for the evils complained of is to be looked for in the abolition of the present examination system. This system is no doubt defective in many ways, and we may perhaps hope that some day it will be replaced by one more accordant with sound educational principles; for the present, however, it exists, and must be recognised as one of the conditions under which our work has to be done. Practical wisdom therefore teaches that instead of trying to get rid of it, we should strive as far as possible to improve it, to lessen its faults, and to develop whatever good it may be susceptible of.

It is admitted on all hands that examinations carried on in direct connection with teaching are of great educational value, of so much value indeed that no careful teacher ever thinks of doing without them. What, therefore, in the interests of sound education, we ought to strive for, in relation to those examinations which are not connected with any system of instruction, is that they should be made, as nearly as possible, what they would be if they did form part of such a system. It is perhaps too much to expect that this should be taken as the leading principle in the case of examinations such as those, now so common in connection with various branches of the public service, which exist for the primary object, not of promoting education, but of preventing dolts and dunces from being supported at the public expense; but, besides these, there are many examinations nowadays, which, though unconnected with teaching, are professedly intended for the advancement of education. Among such examinations, those of the University of London are on many accounts the most important, and the intimate relation between them and much of our work in this College seems to me to be a sufficient reason for considering how far the influence which, through this relation, they exert upon our teaching, is beneficial or otherwise.

If any further justification be needed for discussing the educational tendency of the examinations of the University of London, beyond the general one arising from the paramount importance of the improvement of education, it may be found in the history of the University. It is doubtless known to many of my audience that the University of London was constituted, in most essential respects as it now exists, by a Royal Charter dated December 5, 1837, in order, "for the advancement of religion and morality, and the promotion of useful knowledge, to hold forth to all classes and denominations of [her Majesty's] faithful subjects, without any distinction whatsoever, an encouragement for pursuing a regular and liberal course of education." The form which this encouragement was to take was that of "ascertaining, by means of examination, the persons who have acquired proficiency in Literature, Science, and Art, by the pursuit of such course of education, and of rewarding them by Academical Degrees, as evidence of their respective attainments, and marks of honour proportioned thereto;" and it was directed that all persons should be admitted as candidates for degrees in Arts and Laws, who should produce certificates of having completed the course of instruction prescribed by the University either in *this* College or in King's College, London, or in any other such institution as might be authorised by the Crown to issue such certificates. But in 1858, the Senate of the University obtained a new charter by which they were empowered to admit candidates to the examinations for degrees in Arts, Laws, Science, and Music without requiring them to have previously pursued any prescribed course of study, or to have attended any particular place of instruction; and since that time no other qualification has been demanded of graduates of the University of London (with the exception of those who have taken degrees in Medicine) than the ability to pass the appointed examinations. I do not now propose to discuss the question whether the passing of an examination only affords as good ground for conferring academical distinction as the passing of the same examination combined with studentship at some recognised college or other educational institution; my object at present is simply to draw attention to the fact that the University of London, created in order to encourage the pursuit of "a regular and liberal course of education," no longer requires candidates for degrees in Arts or in Science to pass through any collegiate course, but considers that she sufficiently fulfils her mission by devising and carrying out into practice a system of examinations. It appears to me that this fact justifies all who are interested in the progress of sound education in demanding that these examinations should be so arranged as to encourage to the utmost possible extent thorough study and conscientious teaching.

---

[*] Introductory Lecture delivered at the opening of the Session of the Faculties of Arts and Laws and of Science, in University College, London, on Monday, Oct. 5, 1874, by G. Carey Foster, F.R.S., Professor of Physics.

The present Regulations of the University do not in all cases seem to me to fulfil this condition as completely as they might do, and I therefore think that I may suitably make use of this opportunity for trying to point out their defects as definitely as I can, and for attempting, if possible, to suggest improvements. I need hardly say, however, that whatever criticisms or suggestions I may venture to make will refer almost exclusively to the Regulations affecting that branch of science, namely Physics, with which I am specially connected. I believe, nevertheless, that the general principles which it is of greatest importance to keep in view in framing an examination in any department of knowledge are very nearly the same, and therefore I venture to hope that if the reflections which my experience of the London University examinations, both as an Examiner and as a Teacher, has suggested to me, are of any value in relation to my own subject, they may not be quite worthless in relation to others.

In order to apply to the case of Physics the general principle that examinations and direct teaching ought to be only different ways of attaining the same object, it is needful to consider first of all what reasons there may be for including the study of Physics in "a regular and liberal course of education," and what ought therefore to be the aim of teacher and examiner alike. With regard to this point, it will probably be admitted that the educational value of the study of Physics depends upon the mental discipline which it ensures, and not upon the individual facts, or even on the general laws, with which it stores the memory. It follows from the nature of the phenomena with which this science deals, that, to a much greater extent than has hitherto been the case with the phenomena of any other branch of science, the exact conditions of their occurrence have been ascertained, and the relations which they bear to one another have been expressed by definite numerical laws. In consequence of the precision which it is hence possible to give not only to statements respecting individual physical phenomena, but also to statements involving general laws, the reasoning by which the conclusions of Physics are established assumes a stricter character than can be attained in any other branch of natural science. It may be confidently asserted that, for training the mind in habits of accurate thinking, no other study can be compared with that of Physics if properly pursued; for, while it affords abundant practice in deductive reasoning of mathematical strictness, it obliges us to give no less attention to the converse process of inferring general laws from particular concrete phenomena and the direct impressions which they make on our senses. It is this combination of deductive with inductive reasoning which constitutes the special value of the study of Physics for the purposes of mental discipline. It is quite true that the deductive processes of Physics are borrowed from Mathematics, and that it shares the inductive method with all the other branches of natural science; but the greater definiteness of physical phenomena, as compared with those of other sciences, not only, as I have already said, leads to a greater definiteness in our general conclusions respecting them, but, as a further consequence, makes it easier to test the truth or falsehood of their conclusions by comparing the results deductively derived from them with the results of new experiments or observations. It may even, indeed, be thought that the comparative definiteness and precision of the problems with which the science of Physics is concerned render the study of it less serviceable, as a preparation for dealing with the complex questions which arise in the common experience of life, than the study of sciences in which the uncertainty and indefiniteness of the data leave a greater scope for the exercise of a judicious tact in the estimation of probabilities; but to maintain such an opinion would be very much like saying that in order to become familiar with the laws of chemical action and the nature of chemical combination, we ought to study the transformations of albumen and chlorophyll rather than the properties of such things as potassium, oxygen, or sulphuric acid. It is of course because physical phenomena are simpler and more accessible to investigation than those of Chemistry or Biology, that greater progress has been made in the study of them, and that the explanations that have been reached are of a higher degree of certainty and generality; but it is precisely the relatively advanced stage which has been reached by it that gives to the study of Physics its high value as an element in general education, and is the reason why it furnishes us with fuller and more instructive examples of scientific reasoning than other sciences.

The nature of the intellectual benefits that have been pointed out as resulting from this study, suggests at once the conditions that must be fulfilled in order to obtain them. If in studying Physics we really undergo, as I have said, a process of training to think correctly, this can only be through the exercise of our minds in following the demonstrably correct trains of thought whereby the general conclusions of Physics have been derived from the observed facts, and through our becoming so familiar with them that, consciously or unconsciously, we take them for our models, whatever may be the subjects to which we require to direct our minds. It follows from this that these benefits do not depend upon the direct results of experiment or observation with which the study makes us acquainted, nor upon the general laws of nature which it reveals to us, but upon the reasoning processes whereby facts and laws are connected together and both are made part of the living body of science. And from this again we see that the kind of teaching and study to be aimed at is that which enables us to trace these processes step by step and to understand their validity; while the kind to be anxiously avoided is that which stores the memory with detached pieces of information, either in the form of facts whose mutual relations are not perceived, or in the form of theoretical conclusions hung up between heaven and earth, and supported neither by revelation from above nor by demonstration from below. This latter, however, is the kind of teaching so much in demand and so frequently offered, which is known by the name of "cramming."

By way of guarding against misconception, it may be well to point out—what, however, is exceedingly obvious—that there can be no reasoning about Physics until the facts of Physics are known, and therefore that the teaching of these facts must always occupy an important place as the indispensable groundwork of all that is to follow. But still it must be remembered that, so long as we are considering the study of Physics merely as a part of general education, the facts of the science are of importance only in relation to the reasoning that is based upon them. Taken by itself, one bit of information is of about as little use in developing the mental powers as any other; it does us about as much good to be told that "heat is a mode of motion" as that "the Government of England is a limited monarchy," and to know the difference between a thermometer and a barometer enlarges the mind to about the same extent as to know how to distinguish a pitchfork from a Dutch hoe.

We may now return to consider the effect of the examinations of the University of London upon the teaching of Physics. These examinations, as we have seen, exist for the express purpose of encouraging the pursuit of "a regular and liberal course of education," or, as it may be otherwise expressed, in order to encourage good teaching and to discourage bad; and in the foregoing remarks I have tried to show as definitely as I can what meaning is to be attached to the words "good" and "bad" in relation to the teaching of Physics. The obvious conclusion, applicable to the particular point to which I now wish to ask your attention, is that examinations are to be regarded as *good* if they induce candidates to *think* about the mutual relations of individual facts and their connection with general principles; while examinations are *bad* in proportion as they lead to the loading of the memory with unconnected scraps of knowledge.

There are two ways in which the examinations of the University of London tend to affect the quality of teaching for good or for evil: first, by the general Regulations drawn up by the Senate in reference to the various examinations, including the list of subjects to be taken up and the specifications of the requirements in each subject; and secondly, the questions set by the Examiners, which form as it were a detailed commentary, authorised by the Senate, on the meaning of their own Regulations. For various reasons, the lowest examinations, or those which come earliest in the University scheme, produce the greatest effect on methods of teaching and learning; for one thing, they affect the greatest number of candidates, and they come at a part of the candidates' career when they are most dependent on external authority or advice as to the course of their studies.

THE BIBLIOGRAPHY OF SCIENCE

THERE can be no surer indication of the universal spread of science during the last few years than the large and annually increasing number of works relating to its various branches that are advertised for publication during each successive season. The considerable element which science now forms in education, in the arts and manufactures, in commerce and agriculture, and in the social economy of life, renders the knowledge of at least its rudiments absolutely necessary in almost every sphere of existence. The particulars given below will show that publishers are fully alive to the importance and value of good works in this department of literature.

Although even now we have a large quantity of educational books of varying degrees of mediocrity and excellence in almost all the commoner branches of science, and the number of works is ever increasing, yet the advance made by science makes it imperative that fresh manuals and class-books and new editions should be continually published, in order that students and workers should be enabled to keep pace with its rapid strides. The works we notice beneath range from the smallest general primer to the most elaborated and matured works in particular and specific branches of science; and among them will be found books by men of the highest reputation in their special provinces. We have endeavoured to notice every work of importance which is to be published during the next few months; but our list is necessarily incomplete; we shall, however, in future numbers note any deficiencies, omissions, or fresh announcements.

In ASTRONOMY we observe the following books:—*The Moon*, and the Condition and Configuration of its Surface, by Edmund Neison, Fellow of the Royal Astronomical Society, &c., illustrated by maps and plates. (Longmans.)—*A Primer of Astronomy*, by J. Norman Lockyer, F.R.S., with illustrations. (Macmillan.)—A new edition of *Navigation and Nautical Astronomy*, in theory and practice, by Prof. J. R. Young. (Lockwood.)—*The Transits of Venus*, a Popular Account of Past and Coming Transits, from the first observed by Horrocks, A.D. 1639, to the Transit of A.D. 2112, by Richard Anthony Proctor, B.A. Cantab., Hon. Fell. King's Coll. Lond., with twenty plates and numerous woodcut illustrations. (Longmans.)

In CHEMISTRY we are promised a new edition of *Dr. Normandy's Commercial Handbook of Chemical Analysis*, enlarged and almost re-written by Dr. H. M. Noad, Ph.D., F.R.S. &c., with numerous illustrations. (Lockwood).—A second edition of *Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe*, from the last German edition, revised and enlarged by Prof. Th. Richter, of the Royal Saxon Mining Academy, translated by Prof. H. B. Cornwall, Assistant in the Columbia School of Mines, New York; this work is illustrated with eighty-seven woodcuts and one lithographic plate. (Sampson Low.)—*Industrial Chemistry*, a Manual for Manufacturers and for use in Colleges or Technical Schools, being a translation by Dr. J. D. Barry, of Professors Stohmann and Engler's German edition of Payen's "Précis de Chimie Industrielle;" edited throughout and supplemented with chapters on the Chemistry of the Metals, by B. H. Paul, Ph.D., with very numerous plates and woodcuts. (Longmans.)—A third enlarged edition of *A Systematic Handbook of Volumetric Analysis*, or the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases, with numerous engravings, by Francis Sutton, F.C.S., Norwich. (Churchill.)—*The Chemical Effects of Light and Photography, in their Application to Art, Science, and Industry*, by Dr. Hermann Vogel. (King and Co.)—A new edition, revised and enlarged, of *Practical Metallurgy*, by John Percy, M.D., F.R.S., Lecturer on Metallurgy at the Government School of Mines. Vol. I., Part 1. Introduction; Fuel, wood, peat, coal, charcoal, coke, refractory materials, fire-clays, &c. Vol. I., Part 2. Copper, zinc, brass. (John Murray.)

In PHYSICS and MECHANICS, Messrs. Longmans will publish the three following books:—*The Elements of Physics*, by Neil Arnott, M.D., F.R.S., the seventh edition, revised from the author's notes and other sources, and edited by Alexander Bain, LL.D., Professor of Logic in the University of Aberdeen, and by Alfred Swaine Taylor, M.D., F.R.S., Professor of Medical Jurisprudence, Guy's Hospital.—*Introduction to Experimental Physics, Theoretical and Practical*, including directions for constructing physical apparatus and for making experiments, by Adolf F. Weinhold, Professor in the Royal Technical School at Chemnitz, translated and edited (with the author's sanction) by Benjamin Loewy, F.R.A.S., with a preface by G. C. Foster, F.R.S., Professor of Physics in University College, London, with numerous wood engravings.—*Lessons in Elementary Mechanics*, introductory to the Study of Physical Science, by Philip Magnus, B.Sc., B.A. This book is adapted to the requirements of the London Matriculation, Preliminary, Scientific, First M.B., and other Examinations.

Messrs. Charles Griffin will issue *A Mechanical Text-Book*, a Practical and Simple Introduction to the Study of Mechanics, by William John Macquorn Rankine, C.E., LL.D., F.R.SS., &c., late Regius Professor of Civil Engineering in the University of Glasgow; and Edward Fisher Bamber, C.E.

In BIOLOGY we have a large number of new books and new editions, of which the following are the most noteworthy:—*The History of Creation*, by Prof. Ernst Haeckel, the translation revised by E. Ray Lankester, M.A. (King and Co.)—*Elements of Human Physiology*, by Dr. L. Hermann, Professor of Physiology in the University of Zurich, translated and edited from the sixth (yet unpublished) German edition, at the author's request, by Arthur Gamgee, M.D., F.R.S., Brackenbury

Professor of Practical Physiology and Histology in the Owens College, Manchester. (Smith, Elder, and Co.)—*Outlines of Animal Physiology*, with engravings on wood, by W. H. Allchin, M.B., M.R.C.P., Assistant Physician to the Westminster Hospital and Lecturer on Practical Physiology, Histology, and Pathology in its Medical School. (Churchill.)—*Notes of Demonstrations on Physiological Chemistry*, by S. W. Moore, F.C.S., Joint Demonstrator of Practical Physiology at St. George's Medical School. (Smith, Elder, and Co.) This work is nearly ready for publication.—The same publishers announce *The Pathological Anatomy of the Nervous Centres*, by Edward Long Fox, M.D., F.R.C.P., Physician to the Bristol Royal Infirmary, with illustrations; and a *Text-Book of Pathological Anatomy*, by John Wyllie, M.D., F.R.C.P.E., Lecturer on General Pathology at the School of Medicine, Surgeons' Hall, Edinburgh, &c.

We are glad to see that Messrs. Churchill have in the press a fifth and revised edition of Holden's well-known work on *Human Osteology*, comprising a Description of the Bones, with Delineations of the Attachments of the Muscles, &c.—The three following new works also belong to the same publishers:—*Frey's Manual of the Histology and Histo-Chemistry of Man*, a Treatise on the Elements of Structure and Composition of the Human Body, for the use of Practitioners and Students, largely illustrated with engravings on wood, translated by Arthur E. J. Barker, L.R.C.S.I., and revised by the author.—*The Student's Guide to Human Osteology*, with numerous lithographic plates, by William Warwick Wagstaffe, F.R.C.S., Assistant Surgeon and Lecturer on Anatomy at St. Thomas's Hospital.—*The Student's Guide to Practical Histology, Histo-Chemistry, and Embryology*, with engravings on wood; by H. A. Reeves, F.R.C.S. Edin., Assistant Surgeon and Demonstrator of Anatomy at the London Hospital.

The only other book we notice in this branch of science is a new edition of *Demonstrations of Anatomy*, being a Guide to the Knowledge of the Human Body by Dissection, by George Viner Ellis, Professor of Anatomy in University College, London, with 248 engravings on wood. The number of illustrations has been largely added to in this edition, and many of the new woodcuts are reduced copies of the plates in the author's work, "Illustrations of Dissections." (Smith, Elder, and Co.)

In GEOGRAPHY and TRAVELS, probably the works most looked for are *The Last Journals of Dr. Livingstone, in Eastern Africa, from 1865 to his Death*, continued by a narrative of his last moments and sufferings, taken down from the mouth of his faithful servants Chumá and Susi, edited by Rev. Horace Waller, F.R.G.S., Rector of Twywell, Northampton, with a map prepared on the spot by the author, and illustrations from his sketches. (Murray); and Sir Samuel Baker's new book, which is entitled *Ismailia*, a Narrative of the Expedition to Central Africa for the Suppression of the Slave Trade, organised by Ismail, Khedive of Egypt, with maps, portraits, and upwards of fifty full-page illustrations by Zwecker and Durand (Macmillan.)

Messrs. Sampson Low, as usual, are to the fore in books of travels. We give the titles and some particulars of seven of them:—*Turkistan*, Notes of a Journey in the Russian Provinces of Central Asia and the Khanates of Bokhara and Kokand, by Eugene Schuyler, Secretary of American Legation, St. Petersburg. This book will be profusely illustrated.—*The Straits of Malacca, Indo-China, and China*, or Ten Years' Travels, Adventures, and Residence Abroad, with upwards of sixty woodcuts from the author's own photographs and sketches, by J. Thompson, F.R.G.S., author of "Illustrations of China and its People." This work contains a narrative of the writer's personal experience and adventures in the Straits of Malacca, Siam, Cambodia, Cochin-china, and China, illustrated with over sixty wood engravings from the author's sketches and photographs. A long residence in the Straits of Malacca enabled the author to visit some of the native states, and to give an account of our important colonial possessions in that quarter of the globe, as also of his personal intercourse with the native Malay rulers, and his estimate of the value of the Chinaman and of Chinese labour in a tropical region.—*The Second North German Polar Expedition in the years* 1869—70, of the ships *Germania* and *Hansa*, under command of Capt. Koldeway, edited and condensed by H. W. Bates, Esq., of the Royal Geographical Society, and translated by Louis Mercier, M.A. (Oxon.) The narrative portion of this important work will be full of interest and adventure in the ice-fields; and, in addition to much matter of great scientific value, will give a graphic account of the hardships and sufferings of the crew of the *Hansa* after the crushing of that ship in the ice.—*Warburton's Journey across Australia*, an account of the Exploring Expedition sent out by Messrs. Elder and Hughes, under the command of Colonel Egerton Warburton, giving a full account of his perilous journey from the centre to Roebourne, Western Australia, with illustrations and a map, edited, with an Introductory Chapter, by H. W. Bates, Esq., of the Royal Geographical Society.—*Captain Tyson's Arctic Adventures;* Arctic Experiences, containing Captain George E. Tyson's Wonderful Drift on the Ice-Floe, a history of the *Polaris* Expedition, the cruise of the *Tigress*, and Rescue of the *Polaris* Survivors, to which is added a General Arctic Chronology, edited by E. Vale Blake, with a map and numerous illustrations.—*The Marvellous Country*, or Three Years in Arizona and New Mexico, by Samuel W. Cozzens, illustrated.—*The Earth as Modified by Human Action*, by George P. Marsh, being a new edition of "Man and Nature."

Mr. Murray announces *Six Months among the Palm Groves, Coral Reefs, and Volcanoes of the Sandwich Islands*, by Isabella Bird, author of "The Englishwoman in America," with illustrations.

Messrs. Trubner have nearly ready *A Peep at Mexico*, Narrative of a Journey across the Republic from the Pacific to the Gulf, in December 1873, and January 1874, by J. L. Geiger, F.R.G.S, with four maps and forty-five original photographs.

In MEDICINE, &c., the announcements are very numerous; we give the more important. Messrs. Longmans have in the press *A Dictionary of Medicine*, edited by Richard Quain, M.D., F.R.S., assisted by numerous eminent writers.

Messrs. Charles Griffin will publish very shortly *Outlines of the Science and Practice of Medicine*, a Handbook for Students, by William Aitken, M.D., F.R.S.

From Messrs. Churchill we receive notice of the following forthcoming books among a long list of others, viz.:—*Air, Water, and Sewage*, a Manual of Analysis for Medical Officers of Health, &c., by Francis Sutton, F.G.S., and William Thorp, B Sc., F.C.S.—*A Handy-Book of Forensic Medicine and Toxicology*, with numerous wood engravings, by W. Bathurst Woodman, M.D. St. And., Assistant Physician and Lecturer on Physiology at the London Hospital, &c., and C. Meymott Tidy, M.A., M.B., Medical Officer of Health and Food Analyst for Islington.—*Experimental Investigation of the Action of Medicines*, a Handbook of Practical Pharmacology, with engravings, by T. Lauder Brunton, M.D., D.Sc., Lecturer on Materia Medica in the Medical College of St. Bartholomew's Hospital.—*The Diseases of Tropical Climates and their Treatment*, with Hints for the Preservation of Health in the Tropics, by J. A. B. Horton, M.D. Edin., F.R.G.S., Staff-Assistant-Surgeon of the Army Medical Department.—*The Face, Mouth, and Throat*, the Surgical Treatment of their Diseases, Injuries, and Deformities, with engravings on wood, by Francis Mason, F.R.C.S., Senior Assistant Surgeon and Lecturer on Anatomy at St. Thomas's Hospital.—*The Student's Guide to the Diseases of the Eye*, with engravings, by Henry Power, M.B., F.R.C.S., Senior Ophthalmic Surgeon to St. Bartholomew's Hospital.—*Report on the Issue of a Spirit Ration during the March to Coomassie*, by E. A. Parkes, M.D., F.R.S., Member of the General Medical Council.—*The Student's Guide to the Practice of Midwifery*, with engravings, by D. Lloyd Roberts, M.D., Vice-President of the Obstetrical Society of London, Physician to St. Mary's Hospital, Manchester.—*Clinical Studies of Disease in Children*, by Eustace Smith, M.D., F.R.C.P., Physician to the King of the Belgians, Physician to the East London Hospital for Children.

Messrs. Charles Griffin have nearly ready *A Dictionary of Hygiene and Public Health* (with illustrations), comprising Sanitary Chemistry, Engineering, and Legislation, the Dietetic Value of Foods, and the Detection of Adulterations, based on the "Dictionnaire d'Hygiène Publique" of Prof. Ambroise Tardieu, by Alexander Wynter Blyth, M.R.C.S., L.S.A., A.R.C., Medical Officer of Health, and Analyst to the County of Devon.

Messrs. Smith, Elder, and Co. also promise us a work *On the Curative Effects of Baths and Waters*, being a Handbook to the Spas of Europe, by Dr. J. Braun, with a Sketch on the Balneotherapeutic and Climatic Treatment of Pulmonary Consumption, by Dr. L. Rohden, an abridged translation from the third German edition, with Notes, by Hermann Weber, M.D., F.R.C.P., London Physician to the German Hospital.

The following BOTANICAL BOOKS are advertised as coming out this season:—*Medicinal Plants*, by Robert Bentley, F.L.S., Professor of Botany in King's College, London, and Henry Trimen, M.B., F.L.S., of the British Museum, and Lecturer on Botany at St. Mary's Hospital Medical School. This work will include full botanical descriptions and an account of the properties and uses of the principal plants employed in medicine, especial attention being paid to those which are officinal in the British and United States Pharmacopœias. The plants which supply food and substances required by the sick and convalescent will be also included. Each species will be illustrated by a coloured plate drawn from nature. This will be published in monthly parts, and Part I. will be ready very soon (Churchill.)—*Pharmacographia*, a History of the Principal Drugs of Vegetable Origin found in Commerce in Great Britain and British India, by F. A. Flückiger and D. Hanbury, F.R.S. (Macmillan.)—*The Primæval World of Switzerland*, by Prof. Oswald Heer, of the University of Zurich, translated by W. S. Dallas, F.L.S., and edited by James Heywood, M.A, F.R.S., with numerous illustrations. (Longmans.)

In the Sciences of GEOLOGY and MINERALOGY, &c., we are promised *Geology, for Students and General Readers*, embodying the most Recent Theories and Discoveries, by A. H. Green, M.A., Professor of Geology and Mining in the Yorkshire College of Science. Part I. The Elements of Physical Geology, with upwards of 100 illustrations by the author. Part II. The Elements of Stratigraphical Geology, with upwards of 100 illustrations by the author. (Daldy, Isbister, & Co.) The same publishers also have *Geological Climate and Time*, a Theory of Secular Changes of the Earth's Climate, by James Croll, of H.M. Geological Survey; *A Treatise on Mining*, by Lottner and Serlo, of the Berlin Academy of Mining, translated from the German by Prof. Le Neve Foster and Mr. Galloway, with 268 illustrations and diagrams; and *The Creation*, or Dynamical System of the Earth's Formation, in accordance with the Mosaic Record and the latest Discoveries of Science, by Archibald T. Ritchie.—*The Origin of Creation*, or the Science of Matter and Force, a New System of Natural Philosophy, by Thomas Roderick Fraser, M.D., and Andrew Dewar. (Longmans.)—*The Dawn of Life upon the Earth*, by J. W. Dawson, LL.D., F.R.S., F.G.S., Principal and Vice-Chancellor of McGill University, Montreal, with illustrations. (Hodder and Stoughton.)

Finally, among MISCELLANEOUS BOOKS the following will probably interest the majority of our readers:—A new edition is nearly ready of *The Origin of Civilisation and the Primitive Condition of Man*, Mental and Social Condition of Savages, by Sir John Lubbock, Bart., M.P., F.R.S. (Longmans.)—*Outlines of Cosmic Philosophy, based on the Doctrine of Evolution, with Criticisms on the Positive Philosophy*, by John Fiske, M.A., LL.B., formerly Lecturer on Philosophy at Harvard University. (Macmillan.)—*On the Sensations of Tone*, as a Physiological Basis for the Theory of Music, by Prof. H. Helmholtz, translated (with the author's sanction) from the third German edition by Alexander J. Ellis, F.R.S., F.S.A. (Longmans.)—*Out of Doors*, a selection of original articles on Practical Natural History, by the Rev. J. G. Wood, M.A., F.L.S., author of "Homes without Hands," &c., with six illustrations, from original designs engraved on wood by G. Pearson. (Longmans.)—*Insects Abroad*, being a popular account of foreign insects, their structure, habits, and transformations, by the Rev. J. G. Wood, M.A., F.L.S., illustrated with 600 figures by E. A. Smith and J. B. Zwecker. (Longmans.)—*The Aërial World*, by Dr. George Hartwig. (Longmans.)—*Memoir of Sir Roderick Murchison*, including extracts from his journals and letters, with notices of his scientific contemporaries, and a sketch of the rise and progress, for half a century, of Palæozoic Geology in Britain, by Archibald Geikie, LL.D., F.R.S., Murchison Professor of Geology and Mineralogy in the University of Edinburgh, and Director of the Geological Survey of Scotland. (Murray.)—*The Physics and Philosophy of the Senses*, or the Mental and the Physical in their Mutual Relations, by R. S. Wyld, F.R.S.E., illustrated. (King and Co.)—*The Elements of the Psychology of Cognition*, by Robert Jardine, B.D., D.Sc., Principal of the General Assembly College, Calcutta. (Macmillan.)—*On Parasites in the Animal Kingdom*, by M. Van Beneden. (King and Co.)—*The Doctrine of Descent and Darwinism*, by Prof. Oscar Schmidt. (King and Co.)—*Optics*, by Prof. Lommel, profusely illustrated. (King and Co.)—*Fungi*, their Nature, Influences, and Uses, by the Rev. M. J. Berkeley and Dr. M. Cooke, profusely illustrated. (King and Co.)—*Scientific London*, an account of the History and present scope of the principal Scientific Societies and Institutions of London, by Bernard H. Becker. (King and Co.)

THE NEW REPTILE-HOUSE IN THE JARDIN DES PLANTES

THE new house for Reptiles and Batrachians in the Jardin des Plantes at Paris was opened to the public last week. It contains four divisions: two larger central, and two smaller end compartments, all connected by folding doors. The front larger compartment is fitted up in the middle with large shallow tanks for the Crocodilia, of which there are five examples of *Crocodilus vulgaris*, *C. frontatus*, *Alligator mississippiensis*, and two species of *Jacare*. In front is a row of glass cages for Snakes—Boas, Pythons, and various Colubrines. The second larger compartment is devoted chiefly to Batrachians, and contains various Salamanders (*Triton*, &c.), and a large number of Axolotls (*Siredon*). In one tank are the two celebrated specimens of this most abnormal of creatures which have got rid of their external gills and converted themselves into the Salamandroid form, *Amblystoma*. In one of the end compartments are the venomous snakes; in the other, Lacertilia of various kinds.

The cages for the Snakes are fitted up with moss, earth, and stones, which are certainly prettier and more natural than the gravel and blankets used for the same purpose in our Zoological Gardens. But the difficulty seems to be that the animals conceal themselves and are not easily extracted from their hiding-places, whereas a blanket is readily unfolded when the occasion requires, and is more easily kept clean and tidy.

There can be no question of the great improvement of this house as compared with its predecessor, nor of its superiority to the Reptile-house in our Zoological Society's Gardens, so far as concerns space and arrangement. But as regards the extent of the collection, we believe the London Society still holds its own.

NOTES

SEVENTY-FIVE cases of specimens taken by the *Challenger* expedition have been received at the Admiralty from Prof. Wyville Thomson.

THE vessel bearing the French Transit Expedition, under charge of M. Janssen, was caught in the typhoon which swept over Hong Kong on Sept. 23; although the ship appears to have suffered, the *personnel* and apparatus are happily safe. We may state that M. Janssen's wife accompanies him.

FROM the list of the lectures to be delivered during the present term at Oxford, on subjects connected with Natural Science, the want of organisation among the teachers of its different branches is but too apparent. The four biological courses—by Prof. Rolleston (1), Mr. Lankester at Exeter College (2), Mr. Barclay Thompson at Christ Church (3), and Mr. Chapman at Magdalen (4)—are to be on (1) The Comparative Anatomy of Vertebrata, (2) The Structure and Genealogy of Vertebrata, (3) Ichthyic Anatomy, (4) The Anatomy of Vertebrata; so that no provision is made for those who are studying Human Anatomy, nor the Invertebrata. Histology fares hardly any better, for its rapid progress during the last few years has quite overthrown the practical microscopy of ten years ago. The Professor of Experimental Philosophy and Dr. Lee's Reader in Physics are also both to lecture on Electricity.

SIGNOR L. M. D'ALBERTIS, the Italian naturalist, who recently ascended the Arfak Mountains in New Guinea and made so many important discoveries, is now at Genoa preparing for a fresh expedition into the same country, and will leave Europe in about a month's time. On this occasion the traveller will endeavour to penetrate into the southern part of that *terra incognita*, that is into the district adjacent to Torres Straits, where mountain-ranges of considerable altitude are known to exist. Should he succeed in his arduous enterprise, there can be no doubt that he will reap an abundant harvest, as the zoology of this part of New Guinea is absolutely unexplored.

SIGNOR D'ALBERTIS' former companion, the distinguished botanist, Dr. Beccari, is still in the East. His last letters, dated at Macassar in August last, announce his recent return there from an excursion into the south-eastern districts of Celebes. We believe that Dr. Beccari also is preparing for a fresh expedition to New Guinea.

UNDER the sanction of the trustees of the British Museum, the course of twelve lectures on Geology, which the liberal endowment of Dr. Swiney makes *free to the public*, will this year be delivered by Dr. Carpenter, at the Birkbeck Literary and Scientific Institution, Southampton Buildings, Chancery Lane, on Saturday evenings, at half-past seven o'clock, commencing Saturday next. We understand that the main purpose of the course will be to elucidate the past history of the earth by the study of the changes at present in progress; and that the course will include an account of the lecturer's own researches in the deep sea. It will be illustrated by an extensive series of photographs and paintings, exhibited by the oxy-hydrogen lantern.

THE South African correspondent who sent us the Natural History Notes which appeared in NATURE, vol. x. p. 486, is Mr. J. P. Mansell Weale.

IT has been decided to publish, as a yearly volume, a Record of Works on Geology, Mineralogy, and Palæontology, British and Foreign. The first volume will be printed by the middle of 1875, and will contain short abstracts or notices of papers, books, maps, &c., published during the year 1874. It is estimated that this volume will contain from 200 to 300 pages, and that its price will be 10*s.* 6*d.* The gentlemen named below have volunteered to assist in the work, which has already been begun. Those marked * have taken charge of various sections (as sub-editors), and the last has undertaken the post of general editor:—* W. Carruthers, F.R.S. (British Museum); C. E. De Rance, F.G.S. (Geological Survey); R. Etheridge, jun., F.G.S. (Geological Survey of Scotland); D. Forbes, F.R.S.; Prof. Geikie, F.R.S. (director of the Geological Survey of Scotland); * Prof. A. H. Green, F.G.S.; Prof. T. R. Jones, F.R.S.; A. J. Jukes-Browne, F.G.S. (Geological Survey); * G. A. Lebour, F.G.S.; * L. C. Miall (Leeds Museum); E. T. Newton, F.G.S. (Jermyn Street Museum); Dr. H. A. Nicholson, F.G.S.; * F. W. Rudler, F.G.S. (Jermyn Street Museum); E. B. Tawney, F.G.S. (Bristol Museum); * W. Topley, F.G.S. (Geological Survey); Henry Woodward, F.R.S. (British Museum); H. B. Woodward, F.G.S. (Geological Survey); W. Whitaker, F.G.S. (Geological Survey). The work will be greatly helped if Provincial Societies and Field Clubs will forward copies of their publications to the editor. It is hoped, from the low price, that the number of subscribers will be enough to cover the expenses of printing; but should this not be the case, a number of eminent scientific gentlemen have kindly consented to act as guarantors. Names of intending subscribers, and of societies and institutions that will purchase the Record for 1874, will be gladly received by the editor.

MR. WILLIAM DITTMAR, F.R.S.E., Lecturer on Chemistry at Owens College, Manchester, has been appointed Professor of Chemistry at Anderson's University, Glasgow, in the place of Dr. Thorpe, who has been elected Professor of Chemistry at the Yorkshire College of Science.

DR. WILLIAM STIRLING has been appointed assistant to Dr. Rutherford, the newly elected Professor of Physiology in the University of Edinburgh.

DR. JAMES APJOHN has resigned his appointment of Professor of Chemistry in the Medical School of Trinity College, Dublin.

MR. BRYCE M. WRIGHT, the well-known collector of fossils, who for some time past had been far from well, died last week.

A NEW wing has been quite recently added to King's College, London, by means of which considerable improvements have been made in the Physiological Laboratory and the Dissecting Room.

Two scholarships in Science, of the value of 100*l.* each, have this year been awarded at St. Bartholomew's Hospital; one to Mr. Coates, of Balliol College, Oxford, the other to Mr. Saunders, of Downing College, Cambridge, these gentlemen having been coupled as of equal merit for the first place in the competition.

THE following gentlemen have been elected to the vacant Natural Science Postmasterships in Merton College:—Mr. J. Larden, of Rugby School, and Mr. A. Macdonell, of Aberdeen University. The Delegates of Unattached Students of Oxford University give notice that the Master and Court of Assistants of the Clothworkers' Company have offered three exhibitions of 50*l.* a year each, tenable for three years, for the encouragement of the study of natural science; the first examination to be held at the beginning of the Hilary Term 1875; at which time one exhibition will be awarded. Gentlemen who shall have matriculated in the present term, or who have not yet matriculated, are eligible for this exhibition.

The following sonnet on the late Dr. Jeffries Wyman appears in the New York *Nation*, with the initials "J. R. L.":—

> "The wisest man could ask no more of Fate
> Than to be simple, modest, manly, true,
> Safe from the Many, honoured by the Few;
> Nothing to court in World, or Church, or State,
> But inwardly in secret to be great;
> To feel mysterious Nature ever new,
> To touch, if not to grasp, her endless clew,
> And learn by each discovery how to wait;
> To widen knowledge and escape the praise;
> Wisely to teach, because more wise to learn;
> To toil for Science, not to draw men's gaze,
> But for her lore of self-denial stern;
> That such a man could spring from our decays
> Fans the soul's nobler faith until it burn."

A telegram from Berlin states that Major von Mechow will shortly start by sailing vessel from Rotterdam to succeed Dr. Lohde, who is in ill health, in the military command of the scientific expedition which left Europe in June 1873, under the leadership of Dr. Gussfeldt, for the exploration of Central Africa. The Berlin African Society will also send out a second expedition under the leadership of Captain von Homeyer, which will leave at the end of December. It will first proceed to Canandge, on the frontier of Angola, and will endeavour to reach the capital of Muata-Jamvo.

The Austro-Hungarian explorers of the North Pole are preparing a popular edition of their adventures, as well as a scientific narrative.

We learn from *Iron* that a scheme has been recently devised for supplying London with an inflammable mixture of gases to replace coal. The new gas, termed "pyrogen," consists of a mixture of nitrogen and carbonic oxide, three-fourths by weight consisting of the latter gas. The temperature of combustion of the mixture is stated to be 2,700° C.; and for heating purposes the flame of the burning gas is to be allowed to raise some good radiating substance to incandescence in an ordinary grate. It is justly pointed out that with our present arrangements three-fifths of the available heat of coal are wasted, but, on the other hand, it must not be forgotten that on the proposed plan the force evolved in the oxidation of the carbon (in whatever form it is made use of) to carbonic oxide is likewise wasted. We should prefer, on the whole, to see some feasible plan for utilising the waste heat of coal, as the highly poisonous nature of carbonic oxide would, in the absence of all other objections, be a serious obstacle to its introduction into our dwelling-houses.

At an influential meeting held at Manchester on Monday, to take measures to secure some permanent memorial of the late Sir William Fairbairn, it was resolved to raise funds for the purpose by public subscription, and "that the permanent memorial of Sir William Fairbairn be in the form of a statue of such a character and to be placed in such a position as may be hereafter determined, and also for a scholarship or some other suitable endowment in connection with the Owens College." It was understood that the scholarship or endowment should have special reference to the teaching of engineering or pure mechanics.

Mr. John Horne, of the Botanic Garden, Mauritius, who is now on a botanical expedition in the Seychelles, writing to Dr. Hooker, says that he has visited the islands of Silhouette, Praslin, and Félicité, searching them from the sea-shore to the tops of the highest hills, in Silhouette up to 2,200 ft., at which elevation Pitcher-plants abound, hanging in immense clusters over every stone, bush, and tree. Flowers of these Nepenthes were obtained, and arrangements made for procuring a good supply of plants. When these materials come to hand it will be seen whether the Nepenthes of Silhouette is different from the *N. wardii* which grows in Mahé. The tops of these mountains where the Pitchers grow have a perpetual moisture hanging over them, being almost constantly enveloped by mist and rain.

We have received an excellent little Italian work—price only two francs, notwithstanding its many illustrations. It is entitled "Parassiti Interni degli Animali Domestici," and is a translation of the well-known little English work on the subject, by Dr. Spencer Cobbold, F.R.S. The Italians are very anxious to make themselves acquainted with English scientific works, and this translation by Dr. Tommasi, as well as the admirable translation of Huxley's "Vertebrate Anatomy" by Prof. Giglioli, show their earnestness.

The fifth volume of the "Annali del Museo Civico di Storia Naturale" of Genoa, just issued, is occupied with an excellent memoir on the Ornithology of Borneo, prepared by Count Tommaso Salvadori, of Turin. The memoir is based on the collections made in Sarawak in 1865 and subsequent years, by the Marquis Giacamo Doria and Dr. Odoardo Beccari, which contained about 800 specimens. All previous authorities on the birds of Borneo have been consulted, and the result is a complete *résumé* of all that is yet known upon the ornithology of this most interesting country, which will be highly acceptable to naturalists.

At two o'clock p.m. on the 18th inst. a severe shock of earthquake was felt at Malta. There was a heaving motion, accompanied by an explosive noise resembling the bursting of a shell. Eight slight shocks followed later. Several buildings are injured, but no casualties are reported.

A telegram, dated Bombay, Oct. 17, states that a cyclone in Bengal has caused a total interruption of telegraphic communication with Calcutta. Fifty miles of the line are reported to have been blown down, and a passenger train has been thrown off the rails. No further details of the damage done have yet been received.

The Council of the Labour Representation League have drawn up a Report founded upon the resolutions adopted by the members at a meeting held some weeks since touching the endowed schools in their relation to technical education. The Report, which deals very fully with the question, and which will shortly be published *in extenso*, recommends a scheme of technical training under four heads, viz.—1. In our elementary board schools. 2. The secondary industrial schools. 3. The higher endowed schools, such as Eton, Harrow, &c. 4. The Science and Art Department at South Kensington. The scheme will be submitted to a general meeting of workmen and others interested in the question, for discussion and approval. The Council of the League express themselves very sanguine as to the beneficial results that would follow the adoption of the scheme. In connection with the subject of technical education we may state that the opening meeting of the members of the Artisans' Institute was held on the 14th inst., in the premises of the institution, Castle Street, St. Martin's Lane. The meeting was addressed by the Rev. H. Solly, Mr. Samuel Morley, M.P., Dr. Carpenter, and others, and the promoters are sanguine of its success in educating and elevating skilled workmen.

On Monday evening a public meeting was held in the hall of Clanricarde College, Pembridge Square, Bayswater, Dr. J. H. Gladstone, F.R.S., presiding, to establish a popular society in

West London for the advancement of natural history and physical science. There was a very good attendance, chiefly of members of the various London field clubs. A number of ladies have been received as members, and working men are represented on the committee.

ACCORDING to the *Belgique Horticole*, Dr. Candèze has invented a small photographic apparatus, which he calls a "scenograph," which consists simply of a stick and of a camera the size of an opera glass. To photograph a plant or other object, it is sufficient to place it in the focus of the scenograph for a minute or two. The negatives, it appears, can be purchased ready prepared.

THE opening of the School of Horticulture at Versailles, which was to have taken place on Oct. 1, is postponed till Dec. 1.

DR. A. CORLIEU states, in *La France Médicale* for Sept. 30, that he had occasion to search the registers of the parish of Saint Antoine, preserved in the National Library. It was in the cemetery of the Innocents, in that parish, that the dead bodies from the Hôtel-Dieu were interred; and Dr. Corlieu has ascertained that during the first six months of 1694 the deaths in the hospital amounted to 11,696. In 1873, during the same space of time, the mortality amounted to 770 for 925 beds.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by Mr. J. D. Lloyd; a Ducorps' Cockatoo (*Cacatua ducorpsi*) from the Solomon Islands, presented by Mr. F. J. Dean; two Lions (*Felis leo*) from South Africa; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa; a Sun Bittern (*Eurypyga helias*) from South America, deposited; two European Rollers (*Coracias garrula*), European; a Naked-throated Bell-bird (*Chasmorhynchus nudicollis*) from Bahia; a solitary Tinamou (*Tinamus solitarius*) from Rio de Janeiro, purchased.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopic Science* for this month commences with two articles which are of special interest to embryologists, and therefore to biologists generally. The former of these is by Mr. F. M. Balfour, entitled "A Preliminary Account of the Development of the Elasmobranch Fishes;" it occupies about forty pages, and is fully illustrated. The investigations were conducted at the Zoological Station at Naples, which illustrates the value of that institution, and the justifiableness of Dr. Dohrn's enthusiasm. The earliest stages of development are those most minutely described. The points of greatest interest made out are the following:—(1) The epiblast of the blastoderm in that part which corresponds to the caudal extremity of the future embryo, folds round inwards and becomes continuous with the deeper layers; which leads the author to conclude that, as the hypoblastic origin of the alimentary canal is connected with the presence of a food-yolk, and in origin its those animals which develop an "anus of Rusconi" is not so, the former is but an adaptation. (2) The notochord is shown to be developed from the hypoblast, the mesoblast forming a mass on each side of it. This may depend upon the mesoblast, whose lateral columns just referred to, are "split off, so to speak, from the hypoblast," also developing a median independent sheet; or it may be, which unbiassed observation undoubtedly supports, that the notochord is a true hypoblastic structure. The former of these views, as the author remarks, "proves too much," since it is clear that by the same method of reasoning we could prove the mesoblastic origin of any organ derived from the hypoblast and budded off into the mesoblast. If Mr. Balfour's fundamental fact is verified, it will much modify the argument as to the homology of organs as based upon their embryonic origin. (3) The medullary groove is quite flattened out in the cephalic region at the time that the canal is fully formed in the caudal. This paper is well worthy of careful study.—Mr. Ray Lankester writes on the development of the pond snail (*Lymnæus stagnalis*), and on the early stages of other mollusca. He begins by describing the shell-gland, which is situated below the developing shell; he shows its presence in Lamellibranchs, Gasteropods, Pteropods, also in the Brachiopoda and *Loxosoma*. From this the question is asked whether it in any way corresponds to the pen of the Dibranchiate Cephalopoda and the internal shell of *Limax*. Reasons are given in favour of the plug, which is always found to occupy the shell-gland, being developed into the latter; but with regard to the former, the author, from originally holding the opinion that it has a similar origin, now thinks differently for the following reasons:—The pen of *Loligo* must correspond to the guard of the Belemnite, in which the phragmacone is aborted. This guard is only a sheath to the phragmacone, which again corresponds to the whole shell of *Spirula*. The shell of *Spirula* must have been preceded by the shell-gland, therefore the plug of the latter cannot have been the direct origin of the *Loligo* pen. The latter part of the paper discusses the development of the pond-snail in detail.—Mr. E. A. Schafer describes an ingenious and much-improved microscope warm-stage, in which a mercury valve regulates the gas supply to a small circulating boiler. He remarks that much of the cooling is produced by the proximity of the objective, and suggests that this may be warmed by coiling a tube round it. It has always occurred to us to ask whether the heating of objectives does not injure, for the time being, their optical powers; as they are constructed so as to be achromatic, &c., at the average temperature of the air, and very slight differences must produce material changes in the distance between the lenses and their shape.

Bulletins de la Société d'Anthropologie de Paris, fascicule v. tome 8, 1874.—M. Topinard concludes his paper on the anthropology of Algiers, by drawing attention to the five periods which characterise the anthropological history of the colony, and which are those of the brown-skinned Kabyles; the light-skinned Kabyles; the Numidians, to whom we must refer the greater number of the Berber inscriptions hitherto found; the Romans, Arabs, and Turks; and lastly, the Aryans. M. Topinard is of opinion that in the fair and dark skinned Berbers we have a kindred race with our oldest West-European races, and that therefore, with due regard to locality, we have evidence that European colonies could be made, like those tribes, to flourish in various parts of Algiers. In the meanwhile, however, as General Faidherbe has remarked, it becomes a question of political as well as ethnological importance to investigate and, if possible, arrest the causes which are diminishing the numbers of the native population, whose existence is the more important from their being the best able to bear the climate and cultivate the soil. M. Topinard considers that the mortality among the native races is not to be referred with any special prominence to diseases introduced by Europeans, but is due very much more to a natural scrofulous diathesis antecedent among them, to any imported constitutional taint, while famine, war, and many other causes depending upon political conditions are probably the most important agents in the process.—M. de Mortillet has recalled the attention of the Society to M. l'Abbé Bourgeois' assumed evidence of the existence of man at the base of the Miocene or mean Tertiary, while he presented to them one of the latest of the Abbé's finds of flint implements from the Miocene beds at Thenay, and which in its longitudinal lines showed unmistakable traces of cutting. The speaker pointed out that since the foundation of the calcareous beds at Beauce, and the deposit of the flints at Thenay, the mammalian fauna has been renewed at least three times, while the differences between the extinct and living fauna are sufficient to justify the acceptance of the supervention of specific genera. The question of the existence of man in the mean Tertiary period rests, however, for the present, open, and must await further discoveries of a less questionable nature before it can obtain an unassailable solution.—M. Onimus, in a paper on language, has considered at length the importance of reflex action generally on all phenomena of the nervous system and on the intellectual functions, illustrating his point by reference to the changes in the faculty of speech which give rise to aphasia, and considering the manner in which the latter lesion is modified by the previous and normal mental condition of the patient. This number also contains a suggestive paper, by Madame C. Royer, on the mathematical laws of reversion through atavism; notes by M. Bataillard on the Gipsies of Algiers; and a report of the hairy dog-man of Kostroma, in whom an abnormal development of the hair of the head and the down on the face and neck, combined with considerable prognathism, has similated the characters of the canine head.

The *Bulletin de la Société d'Acclimatation de Paris* for July devotes a considerable portion of its space to the description of an ostrich farm at the Cape of Good Hope. This industry is largely extending in that colony, and yields excellent results. —M. Maumenet gives a valuable contribution in the shape of a paper on the various plants acclimatised by him at Nîmes, in the province of the Gard. Bamboos, Eucalyptus, palms, and several new and useful Chinese plants and vegetables, are among his successful attempts at acclimatisation.—M. Martinet gives details of the mode of cultivating the *Erythroxylon coca* in Peru, a vegetable which the French are desirous of introducing into Algeria and French Guiana.—M. Collenot suggests, as a means of staying the ravages of the Phylloxera, that instead of introducing American vines the wild vines abundant in many parts of France should be carefully cultivated; they produce, in a wild state, excellent fruit, and as they are very hardy, he thinks that they would withstand the attacks of this pest.—A Japanese tree, the Sophora (*Styphnolobium japonicum*), is recommended for cultivation as rivalling the Eucalyptus in many respects. The wood is very hard, and a tree planted in France thirty-five years ago is now 21 ft. in circumference. It resists cold and drought with equal facility.—The silkworm is being acclimatised in the Baltic provinces, and some species of this caterpillar seem able to withstand the cold with ease.

SOCIETIES AND ACADEMIES

London

Royal Microscopical Society, Oct. 7.—Charles Brooke, F.R.S., president, in the chair.—A paper, by Mr. Alfred Sanders, entitled "Supplementary Remarks on the Appendicularia," was read to the meeting by the secretary, in which the author corrected several observations made in the course of a previous paper, and gave an exhaustive description of a species which he believed to be different from any hitherto described, although he refrained at present from naming it as new.—A paper by Mr. Kitton, of Norwich, was also read by the secretary, upon some new species of diatoms found in deposits sent from New Zealand by Mr. H. R. Webb and by Capt. Perry from Colon.—Mr. Slack made some observations on silica films prepared from a solution containing four parts glycerine to one part water, and pointed out the difficulty of obtaining clear definition of the forms presented when high-power objectives of large angle were employed, whereas those with small angular aperture gave good results.—Mr. Stewart drew the attention of the Fellows to a remarkable living organism exhibited in the room by Mr. J. Badcock, of the nature of which very considerable doubt was entertained, the prevailing opinion being that it was either an entozoon or the larval form of some unrecognised animal.

Leeds

Naturalists' Field Club and Scientific Association, Oct. 13.—Mr. Edwd. Thompson, vice-president, in the chair.—A lecture was delivered by Mr. Samuel Jefferson, F.C.S., upon "Volcanic Phenomena." After giving the more familiar facts with regard to the shape and formation of volcanic cones, the nature of the ejected materials, the periods and frequency of eruptions, and the distribution of volcanic energy, and after an exposition of the chief hypotheses which have been framed with regard to the internal condition of our earth, Mr. Jefferson pointed out a coincidence which had not to his knowledge been previously noticed, that the equatorial diameter between the two centres of intensity of volcanic energy, Java and Quito, is shorter by two miles than that drawn at right angles through Africa. Mr. Jefferson explained his views at some length.

Philadelphia

Academy of Natural Sciences, June 2.—Dr. Ruschenberger, president, in the chair.—"Poisonous character of the flowers of *Wistaria sinensis*."—Mr. Meehan remarked that there was a popular belief that the flowers of the *Wistaria sinensis* were destructive to bees. He had himself seen hundreds of dead bees under large flowering plants. He was struck with the fact this season that none were dead under similar circumstances. The flowers were continually visited by the honey bee and others, without, so far as he could see, any fatal results following. It was clear, therefore, that whatever might be the cause of the death of these insects under some circumstances, it could not be from the honey alone.—"Growth of the *Cnicus arvensis*, Hoff." In regard to the rapidity with which plants sometimes grew, Mr. Thomas Meehan observed that, though it was well known that the Canada thistle spread surprisingly, there had been no figures giving its exact growth placed on record. From experiments he found that it spread at an average rate of about three-fourths of an inch of growth per day, equal to maize or other rapid-growing vegetation above ground.

June 16.—Dr. Ruschenberger, president, in the chair.—Prof. Leidy made remarks on the revivification of *Rotifer vulgaris*, showing that when the animals are actually dried they are incapable of being revivified.—Prof. Cope mentioned the capture of a young *Balæna cisarctica*, of forty-eight feet in length, in the Raritan River, near South Amboy. He was informed that the whale was entirely black, and the dorsal line without irregularities.—Prof. Cope explained the distinctive features of the genus Symborodon, one of the gigantic horned mammalia of Colorado, as compared with Titanotherium, exhibiting typical specimens of the latter from the Academy's museum, showing four inferior incisor teeth, while the lower jaw of Symborodon does not possess any.

Paris

Academy of Sciences, Oct. 12.—M. Bertrand in the chair.—The following papers were read:—The enunciation of the principle of the theory of *timbre* is due to Monge, by M. H. Resal.—Letter from M. Langley, director of the Alleghany Observatory, United States, on cyclonic movements, by M. Faye. This paper was an extension of the author's theory of sun-spots. The laws of fluids in rotatory motion round a vertical axis are shown to apply to these phenomena.—M. Daubrée made some remarks in connection with the foregoing paper concerning the indications of circular motion traced in the diluvian deposits of the neighbourhood of Paris.—Critical observations on the employment of the tincture or powder of guiacum for testing the purity of "*kirschenwasser*," by M. Boussingault.—M. C. Sédillot communicated a surgical paper on the subject of preventive trepanning.—Presence of the genus Lepisosteus among the fossils of the Paris basin, by M. P. Gervais.—External linear extraction, simple and combined, of cataract; a surgical memoir, by M. R. Castorani.—Proportion of real to sulphated ashes in the products of the sugar industry, by M. Ch. Violette.—Communications relating to the destruction of Phylloxera were received from MM. Maurice Girard, Mouillefert, Balbiani, &c., upon which remarks were offered by M. Dumas.—New experiments with alkaline sulphocarbonates for the destruction of Phylloxera; method of employing them, by M. Mouillefert.—Researches on the action of coal-tar in the treatment of phylloxerised vines, by M. Balbiani.—On the employment of electro-diapasons of variable periods as tonometers and electric contact breakers, by M. E. Mercadier.—Attempted theory of the formation of the secondary facets of crystals, by M. Lecoq de Boisbaudran.—Microscopic study and proximate analysis of a pumice from Vesuvius, by M. F. Fouqué. Under the microscope this stone was seen to be composed of a multitude of crystals of amphigene united by an amorphous vitreous substance; of crystals of hornblende, pyroxene, peridote, oxide of iron, feldspath, and brown mica irregularly distributed through the mass. An analysis of the amphigenetic crystals proved this mineral to be rich in sodium and calcium; the amphigene from the tufa of Somma is generally potassic.

CONTENTS

Page
The Universities Commission Report, II. 495
Sedley Taylor's "Sound" 496
Marey's "Animal Mechanism," I. (*With Illustrations*) 498
Our Book Shelf 500
Letters to the Editor:—
  Periodicity of Auroras.—Prof A. S. Herschel (*With Illustrations*). 500
  Automatism of Animals.—Alfred R Wallace 502
  Supernumerary Rainbow—Joseph Blackburn 503
  Colour in Flowers not due to Insects.—F. T Mott 503
  Habits of Squirrels 503
The New Vine Disease in the South-East of France, I. (*With Illustration*) 503
Physics at the University of London. By Prof. G Carey Foster, F.R.S 506
The Bibliography of Science 508
The New Reptile-House in the Jardin des Plantes 510
Notes 511
Scientific Serials 513
Societies and Academies 514

THURSDAY, OCTOBER 29, 1874

METEOROLOGY IN FRANCE

WE hail with much satisfaction the movement which has just been made by the French Government in the direction of a more effective organisation than has hitherto existed for the investigation of the meteorology of France. The best results may be expected from the step just taken, which is detailed in the printed documents quoted below,* and when we consider the great contributions made to practical meteorology by Le Verrier, the distinguished head of the Paris Observatory, in the *Bulletin International*, the *Atlas des Mouvements Généraux de l'Atmosphère*, and the *Atlas des Orages* originated under his direction, we may rest assured that these hopes will be fully realised.

In the decree of February 13, 1873, in which the basis of the reorganisation relative to the meteorology of France was laid down, occurred the following resolutions :—

> "1. The investigation of the great movements of the atmosphere and meteorological warnings for the seaports and for agriculture are remitted to the Observatory of Paris.
>
> "2. The working out of the meteorology of the various river-basins of France, and cognate inquiries, is handed over to Commissions representing the different regions and departments of the country, the organising of which the Council of the Observatory is commissioned to prosecute."

In carrying out these resolutions, the meteorological warnings to the seaports were re-established by the Observatory on May 17 of the same year. The duty of issuing meteorological announcements to all departments for the benefit of agriculture, especially in time of harvest, was recognised, and it was at the same time suggested that an inquiry be set on foot with the view of organising a system by which this could be effectually done.

As regards the second resolution, a systematic inquiry into the climate of France had been organised in 1865 by the appointment of Departmental Commissions, and the establishment of a system of observations chiefly by the primary normal schools. At first, when the Departmental Commissions were yet imperfectly organised, it was found necessary to concentrate the observations made over the country in the Observatory of Paris, which undertook their discussion and publication; but this system, which was forced on the Observatory at the time, could not be indefinitely continued with advantage. The grounds for this opinion are stated in these words :—

> "From 1869 the Observatory continued to point out that the discussion of the climatic conditions of the different river-basins of France could not be concentrated in Paris with advantage. It seemed necessary that the large body of skilled meteorologists that had been formed during the four years which had elapsed should boldly take the observations into their own hands, in order to discuss them and deduce from them the scientific truths they may be shown to teach. It was not merely from the advantages which would accrue to meteorology itself by adopting this line of action that the effort towards decentralisation was put forth, but from the intimate bearing which the partition of the work of meteorological inquiry over the whole breadth of the country had on the scientific movement of France, in favouring the spirit of original inquiry and research without which no nation can take a high position in science."

The circumstances which followed hindered the carrying out of these proposals. Subsequently, however, the matter has been resumed and dealt with successfully in several parts of the country, particularly in the basin of the Meuse and over the western sea-board of the Mediterranean, by concerted action on the part of the five departments of Hérault, Gard, Aude, Pyrénées-Orientales, and Lozère. The Astronomical Commission nominated for the purpose of proposing the best measures to be taken in reorganising the astronomical department entered into the same view, and recommended further that inquiries referring to the climate of France be remitted to Regional Committees appointed by departments grouped together according to the river-basins.

> "But it must be observed that the proposed institution of Regional Committees will in no way interfere with the Departmental Organisation, but is intended, on the contrary, to give greater weight and vigour to the operations of the Departmental Commissions, in that united action in certain lines of inquiry is thereby facilitated; it being evident that the area embraced by a single department is too small for the proper study of many of the widespread meteorological phenomena which pass across it. The local Commissions have repeatedly drawn attention to this great disadvantage; the organisation by regions will, however, henceforth give to the departments the means of publishing the results of their inquiries in a more complete form. In correcting the system of centralisation which had been carried to so great an excess, it is not intended to leave the Commissions to themselves, with no connecting link between them and the Central Administration. On the contrary, the Observatory of Paris is specially instructed to be in active and fruitful correspondence with the Departmental Commissions, and to give assistance, as far as the Commissions may desire, in organising them by regions."

The programme, thus briefly sketched, has been only imperfectly followed out, solely on account of the pecuniary difficulties. But these difficulties the National Assembly has now removed by authorising the necessary funds. What then is now required, and what is now asked by the Minister of Public Instruction, is that the Prefects enter in the departmental budgets such a sum as may in each case be required by the Commission, and we are glad to learn that there is no doubt that the request will be generally acceded to. M. de Cumont concludes his letter with the remark · "I shall act in concert with my colleague, the Minister of the Interior, in carrying out the propositions of the decree of Feb. 13, 1873, to secure the regular despatch of the meteorological warnings to those departments whose scientific Commissions are put in possession of the requisite funds to enable them to take advantage of the warnings in the interest of agriculture."

In the meantime, the Observatory has hastened the resumption of the publication of the "Atlas Météorologiques de la France," which has been stopped for some years. To make up for lost time, the first issue, which is ready for delivery, embraces the three years 1869, 1870, and 1871, and consists of four parts, viz. :—

---

* "Letter from M. A. de Cumont, Minister of Public Instruction, to the Préfets of the Departments, Paris, October 9, 1874." "Letter from M. Le Verrier, Director of the Paris Observatory, to the Presidents of the Meteorological Commissions of the Departments, Paris, October 9, 1874."

(1) Discussion of the thunderstorms (*orages*) of these years, illustrated with forty-six maps. (2) Hailstorms, with three maps. This part of the work, which is of so much importance to agriculture, has been unfortunately neglected for some time, but is now to be vigorously prosecuted. (3) Report on the climatic observations made in France, and particularly on the distribution of rain, with four maps. (4) Meteorological memoirs and documents (thirteen in all), contributed by different meteorologists of France and other countries, a section of the work which is expected to receive a fuller development in future issues.*

A noteworthy feature of the publication consists in the fact that the materials which make it up have been collected under the auspices of the Departmental Commissions, and in great part discussed by them. This is, particularly for such a country as France, an admirable arrangement, since there is no European country the working out of the meteorology of which presents a more complex problem, owing to the great diversity of the climates of its different regions; and further, the agricultural interests of no other country would benefit more than those of France, were a correct knowledge of its climate generally disseminated among the people. Now, this feature of the publication gives the local colouring to the reports which is fitted to arrest general attention and secure the putting forth of those local efforts by which alone the meteorology of France can be satisfactorily worked out.

It may be here pointed out that the French meteorological organisation is based on the Commissions which have been appointed in each of the departments; it being to them that the Government, in the decree of Feb. 13, 1873, has remitted the working out of the meteorology of the different river-basins, and inquiries connected therewith. They are invited to unite together for certain objects into Regional Commissions, for the purpose of imparting to their investigations greater breadth and exactness. They are not put under the Central Administration at Paris in the sense of being controlled by it, but are connected with it in order that they may be aided by it in cases where aid is needed. The Departmental Commissions have free automatic action in working out the problem of the local climates of the respective districts which have been entrusted to them.

The programme assigned to the Central Observatory of Paris, consisting of the investigation of the great movements of the atmosphere, and meteorological warnings for the seaports and for agriculture, is too limited in its scope; and we cannot suppose that its illustrious head will be satisfied till he has succeeded in including in the regular work of the Observatory those physical researches we have already strongly advocated in NATURE (vol. x. p. 99) as an indispensable part of the work to be undertaken by the Central Meteorological Office of each country, and which have been more recently and ably stated by Prof. Balfour Stewart and Col. Strange (pp. 476 and 490).

In the same article we urged the necessity of the State and the country working together; indeed, in no other way is it possible successfully to work out the great national questions of storms and of local climates in their bearings on the health, productions, and commerce of the country. In France we see that this essential requisite, of the State and the country working together, has been effected, and it may not be irrelevant to add that the French Government has clearly recognised the position that unaided voluntary efforts are insufficient of themselves to cope with the subject, and that if the undertaking is to be conducted in a manner worthy of the nation and of the ends to be subserved by it, it must be supported with aid from the public funds.

MAREY'S "ANIMAL MECHANISM"*

Animal Mechanism. By E. J. Marey. "The International Scientific Series." (London: Henry S. King and Co., 1874.)

II.

IN his treatment of aërial locomotion, Prof. Marey has been even more successful than in his investigations with regard to progression on land. Nearly two centuries ago the general principles of this subject were very ably worked out by Borelli, who, after having shown that in the wing the anterior margin is rigid whilst the posterior portions are more and more flexible as they go backwards, inferred, as will be self-evident to all, that in the downward stroke of the flying bird the plane of the wing becomes directed downwards and backwards on account of the hinder margin yielding slightly to the resisting air. It not having struck him that the wing was elastic in its horizontal as well as its vertical direction, Borelli assumed that the stroke was strictly vertical.

By a series of experiments, the logical sequence and convincing power of which are perhaps unequalled in any other extant biological problem, Prof. Marey has been able to demonstrate the effects of the horizontal yieldingness of the wing, and to prove that in insects the stroke, instead of being, as Borelli assumed, a simple vertical line, is a vertical figure of 8. In proof of this original and, at first sight, unexpected observation, he shows that if the tip of the wing of a wasp be gilt, and the insect allowed to buzz in a beam of sunlight, a very elongated vertical figure of 8 image is seen, as in Fig. 1, to be produced by the reflecting tip of the rapidly moving wing; "sometimes, indeed, the wing seems to move entirely in one plane, and the instant afterwards the terminal loops which form the 8 are seen to open more and more. When the opening is very large, one of the loops usually predominates over the other; it is generally the lower one which increases, while the upper diminishes. Indeed, by a still greater opening, the figure is occasionally transformed into an irregular ellipse, at the extremity of which we can recognise a vestige of the second loop."

There is still more to be learnt from this simple experiment. By carefully gilding one surface of the wing alone, the buzzing wing, when intensely illuminated, exhibits the figure of 8 of unequal intensity in its two moieties, as seen in Fig. 1; so that it resembles the figure printed thus, 8, if its thick part be considered to represent that which is most illuminated, and its thin part the darker half. This result can only be produced by the plane of the wing being different in the up and down strokes; and, as is found to be the case, the thick limb is reversed by turning the insect round so that it presents its other side to the observer. The same conclusion is arrived at by the employment of the method to be now described.

---

* The price of the volume, post-free to England, is, we understand, 10s. (12 fr.)

* Continued from p. 500.

Without sensibly interfering with the movement of the wing, its tip may be made to come in contact with a revolving cylinder, in which the surface is covered with smoked paper. "Although the figures thus produced are for the most part incomplete, we are able, by means of their scattered elements, to reconstruct the figure which has been shown by the optical method." Fig. 2 is one of the results obtained, in which several of the loops are distinctly seen, as is generally the case when, as here, the insect is so held as to rub the cylinder with the hinder edge of the tip of the wing. That a figure of 8 movement of a point, when made to record on a revolving drum, produces a similar curve, is seen from Fig. 3, which is a tracing of a Wheatstone's kaleidophone rod, tuned to the octave, or, in other words, vibrating twice transversely for each longitudinal vibration.

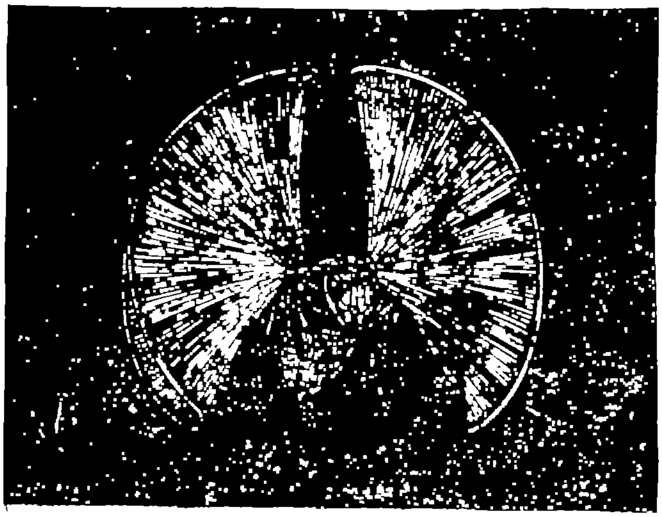


FIG. 1.

Still we are not able to say in which direction the wing is moving in the different branches of the 8 figure; the following simple experiment determines this completely.

FIG. 2.

A slender glass rod is smoked at the tip in the flame of a candle, and held at right angles to the direction in which the wing moves, in the different parts of the wing-tip tract, as in Fig. 4. It is evident that if the wing hits the rod whilst it is descending, it will rub off the smoke film from its upper, and whilst ascending, from its lower surface. Supposing that, in the figure, the head of the insect is directed to the right: when the glass rod enters the loops at b' and a it is found to strike the upper surface; when at b and a', the lower; consequently the arrows indicate the true direction of the wing's motion.

The foregoing facts, when taken in connection with their known anatomical arrangements, place us in a position to discuss the mechanism of the flight of insects. These animals possess muscles, &c., which produce direct downward and upward movements of the wings, and these movements only; therefore the expansion of this vertical line into a figure of 8 must be caused by forces acting external to the thoracic or wing-moving mechanism; in other words, by peculiarities in the structure of the wings themselves. Simple inspection of the wing of a fly shows it to be formed of a rigid, or comparatively rigid, anterior nervure, which supports a thin more yielding membrane behind it. In its descent, the resistance of the air retards the movement of the more yielding posterior portion of the wing sufficiently to cause the lower surface of its

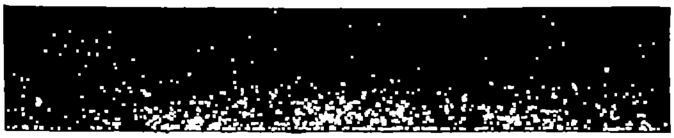


FIG. 3.

otherwise horizontal plane to become directed slightly backwards, and in its ascent the same cause directs it somewhat forward. But an inclined plane striking the air has a tendency to move in the direction of its own inclination; consequently, both in the down and up stroke of the wing, it tends to move forward at the same time. “But this deviation cannot be effected without the nervure being slightly bent. The force which causes the wing to deviate in a forward direction necessarily varies in intensity according to the rapidity with which the organ is depressed. Thus, when the wing towards the end of its descending course moves more slowly, we shall see the nervure, as it is bent with less force, bring the wing backwards in a curvilinear direction. Thus we explain naturally the formation of the descending branch of the 8 passed through by the wing;” and the same theory applies to the ascending branch of the figure.

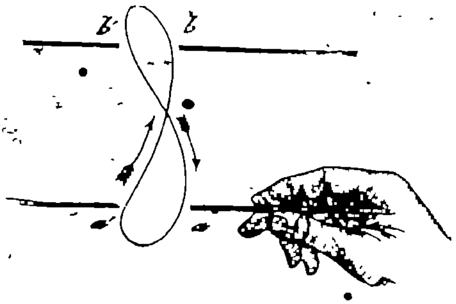


Fig. 4

Acting upon the suggestions of his theory, Prof. Marey has constructed artificial wings, which are planned and move upon the same principle as those of insects. He has not succeeded in making a flying machine, it is true; this, however, is not from any fault in the wings, but because it is impossible to obtain an engine sufficiently light to drive them. He has, however, contrived an apparatus which, when the motor power is supported, is capable of moving horizontally with rapidity, of rising and of falling, just like an insect; and, what is more, when propelled by a simple up and down movement, the tips of the wings describe a figure of 8 of their own accord, as they ought to do upon the theory which led to their construction.

The mechanism of the flight of birds is a problem far more difficult to master than that of insects. The size of the subjects of experiment, and the comparative slowness of the movements of their wings, remove them beyond the reach of the optical and direct graphic method previously employed. Each stroke of the wing has to be recorded through the intervention of a complicated system of tubes and levers, as fragile as they are delicate, and as expensive, as they are liable to be broken. Movements in a single plane are capable of being transferred to paper with comparative ease, but when they are not so limited, and may be in any direction, the necessary complication of the recording machinery becomes immense. The number of little details which have to be continually remembered, and the oft-repeated futile attempts which have to be allowed for, makes Prof. Marey's success in his investigations a matter of more than ordinary surprise. He has mastered the whole subject, having by separate and by combined check methods demonstrated what is the rapidity, direction, and inclination of the wing of the bird in every part of its course. Further than this, he has shown what effects the stroke has on the movements of the body of the bird, and this by a very ingenious new method. The way in which the author invents means for reproducing and originating any quality of movement he may want to develop, must be a source of admiration and almost astonishment to all readers of his work.

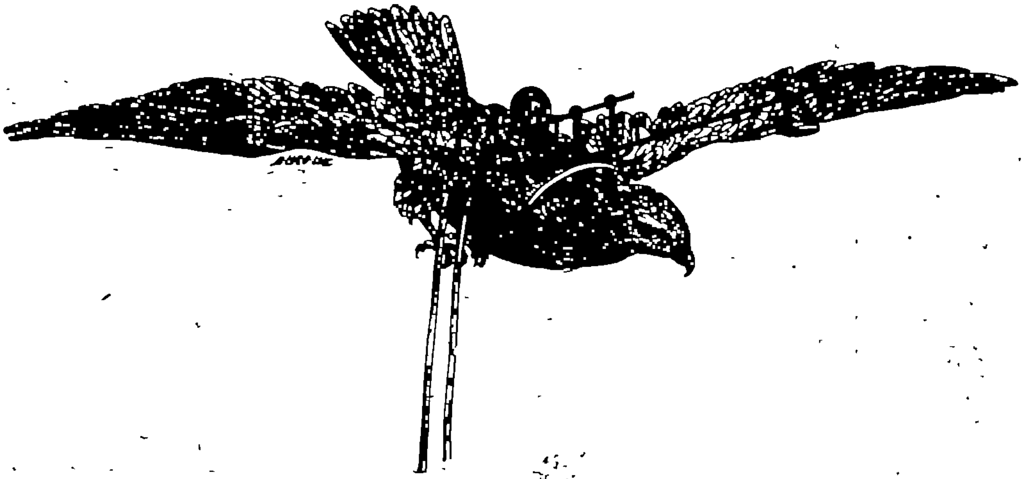


Fig. 5.

Fig. 5 shows a buzzard saddled with the machinery which, by means of the two tubes running downwards from it, transmits the vertical and horizontal movements of its wing to the recording apparatus, which is not represented. In the study of the more intricate points the necessary instruments are so heavy that the whole bird has to be partially supported. This is done by attaching it to the extremity of a long lever which revolves, with scarcely any friction, on a pivot. This is found not seriously to interfere with the normal flight of the bird.

Most of the facts made out by the employment of this apparatus are shown in Fig. 6, which is constructed to illustrate the inclination of the plane of the wing with reference to the axis (Av) of the body of the bird during flight. The direction of the movement of the wing is from H to Av. It shows “that the wing during its ascent assumes an inclined position, which allows it to cut the air so as to meet with the minimum of resistance; while in its descent, on the contrary, the position of its plane is reversed, so that its lower surface turns downwards and slightly backwards." During the descent of the wing the body of the bird is carried forwards as well as upwards. The resistance of the air explains the elliptical form of the figure.

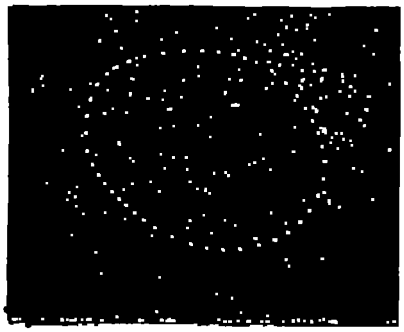


FIG. 6.

We hope that in the short glance which we have taken of some of the most important points discussed in the work before us, we have succeeded in interesting our readers sufficiently in its contents to make them curious to learn more of its subject matter. We cordially recommend it to their attention. To the student of art it gives rules and general principles which will be found invaluable in all attempts to portray the various attitudes of man and his faithful companion, the horse; and these, when understood, will direct attention to the most salient points in the locomotion of other animals.

To the student of physiology it is useful in at least two ways. It shows how invaluable is a knowledge of manipulatory details and the principles of mechanics. Prof. Marey, in the period of his studentship, must have learnt more than the simple routine facts of a medical education. The mechanical Cardan universal joint and Wheatstone's kaleidophone rod are as familiar to him as is the valvular mechanism of the heart; it is his control of method which is one of his most marked characteristics. It shows how elaborate are some of the phenomena which at first sight seem so simple, and how much the science of physiology is within the domain of physics.

The translation, as far as we have had the opportunity of judging, seems a good one, except in one or two cases, where improvement would not be impossible.

OUR BOOK SHELF

The Protoplasmic Theory of Life. By John Drysdale, M.D. (Baillière, Tyndall, and Cox, 1874.)

THE author of this small book is one of the editors of a work on Pathology, by Dr. John Fletcher, of Edinburgh, whose "Rudiments of Physiology" contains much speculative biology of no mean quality. As a disciple he enters into an analysis of the philosophy of his master, discussing its details in connection with the light thrown upon it by modern research, especially the bioplasm theory of Beale. Fletcher argued thus:—The peculiar property, vitality, does not reside in the tissues of the living body indiscriminately, but in one anatomical element alone; because, as the various tissues differ extremely in their physical properties, and these latter are almost exactly the same after as before death, it is hardly to be expected that the living matter can rearrange itself on death, in a short time, into a number of different forms, which shall possess exactly the same physical properties in the vital as in the ordinary state of combination. The concordance of this idea with the theory of Dr. Beale, which divides all tissues into a living forming material (bioplasm), and a dead formed material, the composition of the latter of which alone varies to any extent, must be evident to all; and the working out of its minutiæ occupies several chapters of the work before us. The author also enters fully into the muscle and nerve theory of Dr. Beale in a manner which we do not think will throw much light on either subject. He remarks that the insulating power of the medullary sheath of the nerve-fibre is not demonstrable, therefore "the nerves are not fitted for simple conduction of electric currents; and these have no reason to choose the nerves as their channels, so they spread through the moist tissues almost uniformly." With this opinion we think there are few or no physiologists who will agree, as there is not the least doubt that it is through nerve-fibres that electric stimulation will most readily and most powerfully affect muscular fibres at a distance; otherwise, what is the peculiar value of the "nerve-muscle preparation" of the physiological laboratory? In his remark that Dr. Sanderson is premature in arguing with regard to the Dionæa "that because the contraction of the plant-leaf depends on changes, apparently in the contents of the cells, the muscular contraction of the higher animals is of the same nature," the author is, we think, more fortunate; we have never been able to see that the two phenomena have anything in common. From the consideration of the less speculative protoplasmic theory of the origin of tissues, such points as the nature of life, the connection of force with life and mind, consciousness, and materialism, subjects beyond the pale of precise knowledge, are treated of in a manner which will quite repay perusal by those who are fond of speculating on those precarious topics.

Out of Doors: a Selection of Original Articles on Practical Natural History. By the Rev. J. G. Wood, M.A., F.L.S. (London: Longmans and Co., 1874.)

MR. WOOD is well known as one of the most successful popularisers of natural history. He has himself an extensive and thorough knowledge of his subject, as well as a genuine love of it, and his genial enthusiasm cannot fail to infect the minds of the fortunate boys and girls into whose hands his books may fall. The present volume consists of a number of thoroughly readable papers which have already appeared in various periodicals. They are written in an easy, graceful, chatty style; and, while apparently trying only to amuse his readers, he manages to convey a great deal of valuable information about animals and plants, especially about such as anyone who likes to take the trouble may observe for himself. Some of the papers are concerned with exotic animals, as in that describing "A January Day at Regent's Park," in which are contained many facts concerning the inhabitants of the Zoological Gardens. Most of them are, however, about the "common objects of the country," as is indicated by such titles as "A Sand Quarry in Winter," "Under the Bark," "My Toads," "The Children of the New Forest," "The Repose of Nature," the last concerned with hybernating animals. In "Medusa and her Locks," and "Life on the Ocean Wave" (describing a visit to the Crystal Palace Aquarium), "The Green Crab," &c., we are introduced to the denizens of the ocean. The book is an excellent one to give to a boy or a girl, who, we are sure, would enjoy it, as indeed would many whose boyhood or girlhood is only a sad memory.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

Automatism of Animals and Men

I WAS surprised to see by Mr. Wallace's letter of last week that he and I had understood Prof. Huxley's address in senses entirely different. I understood Prof. Huxley to mean that not only the reflex action of animals, but also all the conscious, so-called voluntary actions of men—those, for example, that we perform for the first time and, as we say, with a conscious end in view—are purely automatic; that is, that consciousness, while it accompanies the workings of the animal machine, never stands in a causal relation to any movement whatever; that no movement ever was the result of a state of consciousness, that every movement is the result of physical antecedents which, being present, the movement must of necessity follow, and that in this physical chain there is no break whatever. Years ago I saw no escape from this conclusion, and I have repeatedly made explicit statements of it in the pages of this journal and elsewhere. I was therefore gratified to find Prof. Huxley agreeing with the doctrine; and that the British public should be so little startled by his announcement of an opinion which has seemed absurd to almost everyone to whom I have attempted to expound it, struck me as rather curious. But the explanation is easy, if a man of such fine and cultured intellect as Mr. Wallace could so completely miss the meaning of Prof. Huxley's discourse.

DOUGLAS A. SPALDING

The Edible Frog

YOUR correspondent Mr. Miller (vol. x. p. 483), will find, in Cooke's "British Reptiles," p. 103, accounts of other endeavours to naturalise *Rana esculenta*. About ten years ago I imported a basket full from the Parisian fish-market, where they can easily be obtained, and turned them out into a pond at Woburn Abbey, in Bedfordshire. They thrived and multiplied there; but our summers are seldom hot enough to enable the tadpole to attain his full development before the cold autumnal nights set in. Last week, for example, I forwarded to Prof. Huxley a living tadpole of *R. esculenta*, born in Bedfordshire, who will scarcely complete his evolution before the winter, though his hind legs are fully developed. I have several summers, however, observed a plentiful supply of young *esculenta*, and I believe that in our climate the young will pass the winter as tadpoles, and complete their transformation in the following spring. But this would require more accurate observation before I can affirm it with certainty. During the past summer I imported from Berlin a fresh supply of 200 exceedingly fine specimens, as my French frogs had been reduced in numbers after the frequent visits of a heron. *R. esculenta* is easily imported in the spring, and will travel many days packed in damp moss. These frogs are easily preserved, being more aquatic in their habits than our *R. temporaria*, who roam through the woods and meadows in search of food when the breeding season is over, while the edible frog remains on the banks of his native pond, into which he plunges, describing a graceful curve, at the slightest approach of danger. They have been introduced into Ireland quite lately, from France, by the Earl of Granard, at Castle Forbes; with what success I am unable yet to say. In the spring any number can be easily obtained from the Parisian market, or the aquarium shop of M. Carbonier, 20, Quai du Louvre, Paris; or from the keeper of the reptiles in the Jardin des Plantes, who always has a plentiful supply to feed his snakes.

The laboratories of our lecturers on physiology are supplied from Leipzig, annually, with living *R. esculenta*, and Mr. Miller can easily obtain the address of the dealers who export them.

Oct. 26 ARTHUR RUSSELL

Colour in Flowers not due to Insects

FROM Mr. F. T. Mott's letter, in your last issue (p. 503), I can hardly imagine him to be acquainted with the literature of the subject on which he writes. The difficulties he suggests, though great, are, I think, not unanswerable.

1. Cultivation seldom greatly affects the size or colour of the first cultivated individual. In the cases in which it does so, Mr. Darwin considers the origin of the variation to be due, as suggested by Knight, to change, or excess in food ("Origin of Species," chap. i.) Where the variation is at first slight and slowly intensified, this is the result of artificial selection.

2. When we consider the exhausting character of the reproductive process, we may perhaps think that the abortion of the sexual organs by the multiplication of phyllæ is the result of weakness; but a high state of cultivation, or any excess of food, predisposes to the degradation of organs, the excessive growth of parenchyma, rapid growth, and disease. Organs are also absorbed by heat or by frost. As to the perpetuation of such forms, Mr. Darwin instances ("Origin of Species," chap. viii.) some varieties of the annual stock which produce both double sterile and single fertile seedlings, justly comparable to the fertile and neuter forms of social insects.

3. The "abortive flowers" of such umbellate and capitulate inflorescences as the Guelder Rose, Hydrangea, and Centaurea, where not effected by artificial selection, act as a lure to the central fertile florets, as shown by Dr. Ogle (*Popular Science Review*, April 1870), originated according to the law of balance of growth.

4. The beauty of fruits "serves merely as a guide to birds and beasts, in order that the fruit may be devoured and the manured seeds disseminated" ("Origin of Species," chap. vi.)

5. "We meet very commonly with gaily-coloured chemical products, essentially connected with the normal processes of development, and originating from venomous infection by insects, or from decomposition. These colours appear to be merely an accidental quality of the chemical products . . . natural selection is without any influence as to colours, unless animals are attracted or repelled by them" (Hermann Muller: NATURE, vol. ix., p. 460). Mimicry has been recorded in fungi (NATURE, vol. vii. p. 55). Mr. Mott's letter indicates the fallacious opinions that mere beauty or variety are objects in nature, and that the Darwinian hypothesis deals with the origin of variations.

G. S. BOULGER

Harrow Road, W., Oct. 26

ABLER pens than mine will probably reply to Mr. Mott's letter in NATURE, vol. x. p. 503; but if not, may I be permitted to point out that the facts therein adduced, as not harmonising with the theory that colour in flowers has been assumed for the purpose of attracting insects, are capable of explanation.

1. *Cultivated flowers.*—The greater size and brilliancy of colour attained by these is not due to cultivation alone, but to selection practised by the cultivator. He chooses his seeds from the plants that bear the largest and best coloured flowers, and thus, directly and intentionally, performs the very work that in a state of nature is carried out, indirectly and unconsciously, by the insect fertiliser.

2. *Double flowers* are only accidental, and not permanent, in a state of nature. The cultivator has succeeded in producing and preserving them by giving a preference to, and propagating from, those plants which bear flowers with a tendency to become double. Here also intentional selection by the gardener has taken the place of natural selection by the insect.

3. The *abortive flowers* of the Guelder Rose and Hydrangea, as they grow naturally, are confined to the outer part of the corymbs, and serve the same purpose as the ray of Compositæ (which in some species consists of neuter florets) and the highly coloured floral bracts of some plants, viz., to attract insects to the fertile flowers they surround. The garden forms of Viburnum and Hydrangea, the corymbs of which are composed entirely or nearly so of sterile flowers, are, like double flowers, the result of intentional selection by the cultivator.

4. The brilliant colours of many succulent fruits have resulted from their superior attractiveness, not indeed to insects for the purpose of fertilisation, but to birds and other fruit-eating animals for the purpose of dissemination, as has been well described by Prof. Hildebrand. The occurrence of brilliant colours in the vegetable kingdom, independently of the agency of insects, as on fruits, galls, fungi, and lichens, is no more irreconcileable with the theory that the colour of *flowers* has been brought about by that agency, than is the occurrence of bright colours on insects themselves and other members of the animal kingdom, or the vivid colour of many mineral substances.

Newton-le-Willows, Oct. 26 THOMAS COMBER

Migration of Birds

I HAVE waited for some time to see if anyone would ask Prof. Newton or Mr. Tegetmeier, on what evidence the latter gentleman has been led to "declare that knowledge of landmarks obtained by sight, and sight only, is the sense which directs these birds," viz., carrier-pigeons. (See NATURE, vol. x. p. 416.) As no one has asked this question, I am obliged to do so myself; but at the same time I should like to say that it is only because the subject is one of great importance that I think we should not here be satisfied with an authoritative statement of opinion, without some indication of the kind and degree of evidence on which such opinion is based. Moreover, it seems to me particularly desirable, that if a man of Mr. Tegetmeier's immense experience in this matter has any conclusive reasons for his decision, the public should have the benefit of their recital; so that the vexed question as to the "homing" of pigeons may once for all be settled.

The importance of settling this question I deem almost impossible to overrate; for, with all deference to Prof. Newton, I do not see why "sight alone cannot be regarded as of much aid to birds which at one stretch transport themselves across the breadth of Europe," if it is once satisfactorily proved that "sight, and sight alone, is the sense which directs" carrier-pigeons, say, from Paris to London. For it must be remembered that carrier-pigeons are descended from a non-migratory species of bird, and may therefore well be supposed not to have the faculty of remembering landmarks so fully developed as is the case in migratory species, where this faculty has doubtless been deeply impressed by means of natural selection. Further, we must not forget that in the case of all migratory birds, the younger generations fly in company with the older ones; so that the former must make several journeys before it devolves upon them to lead the way.

When the instinct question was last discussed in NATURE, I published a summary of the evidence which had been adduced by the correspondence. As at that time I thought with Prof. Newton that the supposition of sight being the faculty to which the return of carriers is due was a very improbable one, I argued that to account for the facts of migration by a similar supposition would be unwarranted. But when so great an authority has found cause to alter his opinion regarding the supposition on which my previous argument was founded, I think the fact bids fair, not only to destroy that argument, but, as just shown, to reverse it. Now I call attention to this in order to show how much depends upon a final determination of the instinct question so far as carrier-pigeons are concerned. In no other case of "homing" (and migration is nothing more) are we able to subject the birds to experiment; so that if this has been done in the case of pigeons with unequivocally positive results, we are at any rate in possession of a valid analogy from which to establish a probability as to the nature of the migratory instinct in general. And the value of this probability would be more definite if Mr. Tegetmeier would tell us what he thinks, or knows, to be the utmost limit of a pigeon's memory for landmarks.

GEORGE J. ROMANES

The Aboriginal "Murri" Race of Australia

(*Communicated by Sir J. Lubbock, F.R.S.*)

HAVING lately had an opportunity of reading your work on "The Origin of Civilisation," it has occurred to me that some information which has come to my knowledge during missionary tours among the aborigines known as the race of Murri, and during a journey afterwards undertaken at the instance of the Government of this Colony to the Namoi and Barwun Rivers, may be acceptable to you. Through Prof. Max-Muller my journal and my grammar of "Kamilaroi, Dippil, and Turrubul" were transmitted to the Anthropological Society; and I suppose all I have written is accessible for the purposes of philosophical investigation among the records of that society. I now confine my statements to points touched upon in those parts of "The Origin of Civilisation" which treat of the Australian aborigines.

Page 11. In the north-western part of this colony, about the tributaries of the Darling, a man will not look at his mother-in-law. If they meet accidentally they turn back to back, and take no further notice one of another.

P. 34. My experience differs entirely from that of Mr. Oldfield. Having shown many drawings and paintings of animals and men—including their own likenesses—to the aborigines, I always found them quick at perceiving the design. They themselves trace on the trees, with their tomahawks, fair representations of snakes and other animals.

P. 199. It is true no man may marry a woman of the same names as his sisters. But it is by no means true, as Dr. Lang stated, on imperfect information, that no one can marry a woman "of the same clan," taking the word "clan" in the common sense of the term as equivalent to "gens." The rule that restricts marriage is founded on an exact law of pedigree and class names. It is as follows among the aborigines of the Namoi; and other tribes have rules similar in the main, though the names differ widely.

The men are all divided into four classes—Murri, Kumbo, Ippai, and Kubbi. The Murri (whose name differs from that designating the race, "Murri," only in the quantity of the last syllable) are regarded as the most important; the Kubbi are the lowest in esteem. The sisters of these four are respectively Mātā (or Matha), Būtha, Ippātā, and Kubbotha (the vowels are pronounced as in French). So that in one family every son bears the name Murri, every daughter the name Mata; in another family every son is Kumbo, every daughter Butha. There is also another classification marked by "totems," in which a second name is given to everyone according to birth. Thus there are the *bundar* (kangaroo), *mūtti* (opossum), *dūlī* (iguana), *nūrai* (black snake), *dīnoūn* (emu), and others. On these classifications are based laws of marriage and descent. A Murri may marry Butha of the same totem, and of any other totem he may take a Mata, though she bears the name of his own sisters, who are all Mata. So Ippai dīnoūn may marry Ippata nurai, but not Ippata dīnoūn. But Ippai dīnoūn may marry Kubbotha dīnoūn.

Children always bear the second name (or totem) of their mother; and the first name of the child depends on the mother's. Thus the sons and daughters of Mata are always Kubbi and Kubbotha; those of Butha are Ippai and Ippatha; those of Ippatha are Kumbo and Butha; those of Kubbotha are Murri and Mata. As Ippai generally marries Butha, Ippai's son is generally Murri, but not always. When Ippai's wife is other than Kubbotha, his son is other than Murri. At first it seemed to me that the father's name determined that of the son; but afterwards I found that it is by the mother's name that those of the children are fixed. It is remarkable that while the second name of a child is the same as the mother's, the first, though dependent on the mother's, is always different. Mata's daughter cannot be a Mata, but is always Kubbotha. The Rev. Lorimer Fison, who had been in communication with Prof. Goldwin Smith and others on the "Tamil" system, and had found that system in Fiji, on seeing the rules of marriage and descent which I had noted down as prevailing among the Kamilaroi of Australia, said the principles of the "Tamil" were observed here also.

They have no words meaning simply brother and sister, but use terms signifying elder brother and younger brother. Thus "daiadī" is elder brother, "gullami" younger brother; and in a family of six brothers the eldest has no daiadī, but five gullami; the youngest has no gullami, but five daiadī; the third has two daiadī and three gullami. "Boādi" is elder sister, "burandi" younger sister. "Gunī" (γυνή) is the child's word for "mother dear."

P. 205. The Kamilaroi and Wiradhuri tribes, who formerly occupied a large territory on the Darling and its tributaries, have a traditional faith in "Baiame" or "Baiamai," literally "the Maker," from *baia*, to make or build. They say that Baiame made everything. Some say that he once lived as a man upon earth; and near the Narran River is a hole in a rock, somewhat in the shape of a man, where they say Baiame used to rest. He makes the grass to grow, and provides all creatures with food. Baiame gave them a sacred wand, which they exhibited at their "bora," the initiatory rite of admission to manhood, and the sight of this wand is essential to make a man. Baiame once showed the black fellows how to get rid of "Mullion," a demon in the form of an eagle, who lived in a tree and devoured many people. Baiame is also the Supreme Judge who awards to men their future lot. When people die, the good ascend to Baiame, and he appoints them a place on the great *warrambool* (watercourse, with groves, fruits, and animals, for the enjoyment of the blessed), in the sky—the Milky Way; the bad perish at death.

The Rev. James Gunther, of Mudgee, who was many years engaged in the instruction of the Wiradhuri tribes, has recorded the fact that these people ascribe to Baiame "three of the attributes of the God of the Bible"—supreme power, immortality, and goodness. There are among them men who make light of these traditions; but even when first spoken with by Christian instructors, some were evidently devout in their thoughts of Baiame and their hopes of a future life; and as to a future state, they generally have a lively expectation. A squatter, M. De Becker, who lived many years at a remote station, where the blacks were in frequent communication with him, told me he had seen many of them die with a cheerful anticipation of being soon in a "better country." WILLIAM RIDLEY

Paddington, Sydney, Australia, July 11

Reported Discovery of Gold in Samoa

FROM a note in NATURE (vol. ix. p. 273) I am surprised to learn that Mr. Williams, H.M.'s Consul in these islands, has stated, in an official despatch to the Foreign Secretary, that gold in quartz has been found on Upolu, in a valley about three miles from the Port of Apia. The samples assayed are said to have yielded at the rate of 3,000 ozs. to the ton.

No geologist who knows Samoa will believe that gold in paying quantities has been found in this island. Still, I think it right to give the following explanation of what gave rise to the above report.

A few months ago gold was said to have been found, as reported by Mr. Williams. Most people here, however, disbelieved it, thinking the report had been raised by unprincipled men for the purpose of attracting settlers and promoting the sale of land. Some believed the pretended specimens of Samoan gold had not been found in Samoa, and felt quite certain they had not been procured in the particular valley specified.

The facts of the case have been lately disclosed, since Mr. Williams left the islands in ill health; he was therefore in ignorance of them when he wrote his despatch from Sydney in October 1873.

The specimens of gold assayed were brought from the Thames gold diggings in New Zealand, and two or three foreign settlers here, who own land in the valley where the gold is said to have been found, raised the report in order to sell their land at a high price. They appear to have imposed upon the credulity of the Consul, who took the specimens to Sydney and had them assayed there. S. J. WHITMEE

Upolu, Samoa, June 2

Photographic Irradiation

I SHALL be obliged if you will allow me space to state more specifically why I am not able to concur in the irradiation theory of Mr. Aitken (vol. x. p. 439). I understand from his last letter that he fully agrees with Lord Lindsay and myself as to the cause of the outer irradiation, and our only difference of opinion now lies in the amount of the inner irradiation that can be traced as due to what he has termed *molecular reflection* within the thickness of the collodion film. Mr. Aitken and Capt. Abney both appear to consider this as the chief cause of the inner irradiation fringe, while I am disposed to rank the irradiation arising from the optical imperfections of the instrument with which the photograph is taken; together with any irradiation that may arise in the wet plate processes from circulation in the film of fluid covering the plate—before—or as very much greater in amount than the irradiation due to dispersion within the collodion film.

We should expect that light dispersed within the thickness of the collodion film would produce its photographic effect in all directions round the illuminated point—and that the area of action would not be affected, or certainly would not be decreased, by covering the front surface of the portions of the collodion film adjacent to the directly illuminated area with an opaque object. Indeed, if the opaque object were a good reflector, such as a bright piece of platinum foil, we might expect slightly to increase the area of photographic action due to dispersion within the film; for the light dispersed towards the front surface of the film would be in great measure reflected back into the thickness of the collodion. But, as I have shown in former letters, placing a piece of platinum foil in immediate contact with the collodion film causes the photographic image of a bright image to be sharply cut off, and no perceptible irradiation can be traced under the edge of the foil.

Again, we should expect the action of dispersed light to extend further within a thick film of collodion than within a thin film; for there would be a greater thickness of illuminated collodion, and the angle through which light could be radiated directly upon the adjacent area without suffering reflection at either surface would be increased, but I have not been able to detect any perceptible difference in the amount of irradiation of similarly exposed plates coated with four thicknesses of collodion and in those coated with but one film.

I have felt myself therefore driven to look for the cause of irradiation either in some circulation taking place within the film of liquid covering the collodion at the time of exposure, which film would be interrupted and its tension greatly altered by the contact of a solid body; or else to seek its explanation in the optical imperfections of the photographic instrument. Possibly, in the wet-plate processes, circulation within the fluid film may produce a very sensible effect. Indeed, there are phenomena which make this more than probable. When a wet-plate picture of a strong light projected upon a dark background is taken with a decided over-exposure of say ten minutes or a quarter of an hour, the inner irradiation fringe is seen to be most opaque on its outer edge; and the phenomenon is so marked that it cannot be held to be an effect of contrast. This, of course, should not be the case if the irradiation edge were due merely to the optical imperfections of the instrument. Again, in the small negatives of the eclipse of December 1871, taken at Dodabetta and Baikul, there is a decided structure in the irradiation under the prominences: under the brightest of them it can be distinctly seen that the opacity of the irradiation fringe is greatest along lines radiating from the prominences—while along the outside, that is, furthest from the prominences, there is an arc of slightly greater intensity. The same structure is traceable in all the negatives, but it is most marked in the Baikul series, and especially in those negatives in which the prominences are most exposed, viz., on the east and west limbs, at the beginning and at the end of totality. This, of course, cannot be accounted for merely by the optical imperfection theory. Again, the little brushes mentioned in a former letter as extending under the edge of the platinum foil, cannot be accounted for without supposing that there is circulation within the liquid film. I hope on my return to England to carry out some further experiments for determining the amount of the inner irradiation which in the wet-plate processes may be due to such circulation. A. COWPER RANYARD

Florence

Curious Rainbow

THE unusual phenomena described by Mr. Swettenham as having been observed by him in a rainbow in the Kyles of Bute (NATURE, vol. x. p. 398), are due, I think, to interference. If I remember rightly, he will find an explanation of the matter in "Deschanel's Natural Philosophy," by Prof. Everett.

Clifton, Bristol, Oct. 19 G. J. THOMSON

Aurora

A BRIGHT display of aurora was seen here on Friday, Oct. 16, between eight and eleven o'clock. At ten o'clock, when I first saw it, the arch of the aurora stretched from Pollux to Arcturus, then both near the horizon, the apex of the arch being under Ursa Major. Deep fringes of light hung from the inner side of the arch and moved with a curtain-like motion to the north. The light was white. On Saturday night numerous streamers were seen darting upwards from the horizon; and many falling stars, two of them leaving trains of light for about a second.

JAMES S. ANDERSON

Castletown, Caithness, N.B.

Sneezing in Animals

I HAVE a rough-coated terrier dog which will sneeze when told to do so. I taught him this trick by repeatedly imitating sneezing in his presence.

When about to perform, he shakes his head obliquely once or twice, just as many people do, and then ends with a good sharp sneeze. J. F. M. H. S.

THE RECENT ERUPTION OF ETNA

PROF. ORAZIO SILVESTRI has published* his observations on the eruption of Etna which occurred on the 29th of August, and reminds us that two months previously he predicted not only the formation of the fissure on the Mongibello side, but likewise the eruption by which it was accompanied.

After an uninterrupted period of eruptive phenomena by which the central crater was considerably modified, at

---

* "Notizie sulla eruzione dell' Etna del 29 Agosto 1874." Catania, 1874.

4 A.M. August 29, subterranean rumblings were followed by two shocks, when a formidable column of black smoke and flaming materials rushed up into the air, and, carried by the wind, fell at great distances, in the form of small scoriæ and sand. Numerous other columns succeeded, with roaring, rumbling noises, lasting for seven hours with great intensity, dying away towards night. The noises ceased on the 30th of August, and vapour and smoke alone rose from the crater and along the line of disturbance.

When the volcanic tremors were most intense, at 4 A.M. 29th August, a fissure appeared on the north side of the great central crater, extending for five kilometers, with an axis running E. by 8° N. The centre of the impellant force was at an elevation of 2,450 metres, between two mountains of lava known as *Fratella Pii* and *Monte Grigio*, where the rent widened to its maximum width of fifty to sixty metres, whence it narrows very steadily towards the base, terminating after a course of three kilometres. And at this altitude, where the greatest thrust was manifested, may be noticed the formation of a new mountain, or crater, with an elliptical contour, coinciding with the fissure in the direction of the axis. It has a diameter of about 100 metres, and covers a superficial area of about 117,734 square metres. This crater, now appearing as a new mountain, is formed of doleritic lava and a pre-historic grey Labradorite, torn from the surface by the black lava of this eruption, in which they are enveloped. There are thus mingled two lavas of the most distant epochs in the history of Etna, the older forming the framework of the mountain. The crater shows internally the usual funnel shape; and near its base, over a width of fifty to sixty metres, there are ten eruptive mouths, open wide, which succeed each other like button-holes;—those nearest the crater are abysses twenty-five to thirty metres in diameter along the line of the fissure. There are also two other groups of small cones, in which the diameter of the mouths is not more than from one to three metres—eight in the second group, and four in the third; so that within a distance of half a kilometre from the crater there are twenty-two minor cones in linear extension. The crack is now continued down a declivity formed by the lava current of 1614, which slopes to the north at an angle of 13° or 14°. Although the rent traverses this lava, there are no more small cones for a distance of 600 metres, when a fourth group of five mouths, each two to three metres wide, is found at an altitude of 2,170 metres; these latter have poured out a torrent of lava descending in a stream 150 metres long, 60 metres wide, and two metres thick. A little lower, at a height of 2,150 metres, is a fifth group of three mouths, more active than the others, but situated like the last group on the great lava stream of 1614. The torrent of lava hurled from these mouths is 400 metres long, 80 wide, and two metres thick, and forms two short bifurcations. Finally, near the end of the crack, at an altitude of 2,030 metres, a sixth and last group of five mouths is formed, which have ejected large quantities of cinder and scoriæ. They are situated about twelve kilometres from the old crater of Mojo, towards which this great crack runs down the side of Etna from its central crater. Besides this principal rent there are an infinite number of smaller clefts, breaking up the soil and radiating from the centres, of great dynamic activity. In a few hours the new mountain and its system of about thirty-five subordinate cones were thrown up, and thus there was brought to the surface a total quantity of about 1,351,000 cubic metres of volcanic materials.

The mingling of the old and new lavas will form the subject of a subsequent memoir. The recent lava, like all modern lavas, is augitic, black, magnetic, and has a metallic lustre. Its specific gravity is 2·3636 at a temperature of 25° Cent. The superficial temperature of the lava was 70°, while at a depth of half a metre it was 90°, and a still higher temperature was recorded where fumeroles were active.

From the remarkably short duration of the eruption, Prof. Silvestri anticipates a more powerful outburst to come, which will be manifested along the rent in making which the present internal explosion has spent its force.

Concurrently with this disturbance the whole of volcanic Italy has been affected. The island of Volcano, after a century of quiescence, discharged cinders and flaming materials from its vast crater for nine months previous to the eruptive phenomena of Etna in the autumn of 1873. The eruption of Volcano continued decreasing in intensity through July 1874, and traces of it are still continually seen. Stromboli last June made a rare eruption, sending out small stones with great energy in place of its characteristic feeble incessant explosions.

Vesuvius has not been unsympathetic, and discharged an unusual volume of dense vapour at the end of August contemporaneously with the eruption of Etna.

THE SECOND AUSTRO-HUNGARIAN EXPEDITION TO THE NORTH POLE, UNDER WEYPRECHT AND PAYER, 1872—74.

ON the return of the Austrian North Polar Expedition we gave in NATURE, vol. x. p. 439, an outline of the discoveries made. From the original memoirs on the achievements of the voyage, by Dr. A. Petermann, Dr. Joseph Chavanne, and Dr. v. Littrow, which have been kindly forwarded to us by the first-named, along with the map, we are able to give still further details.

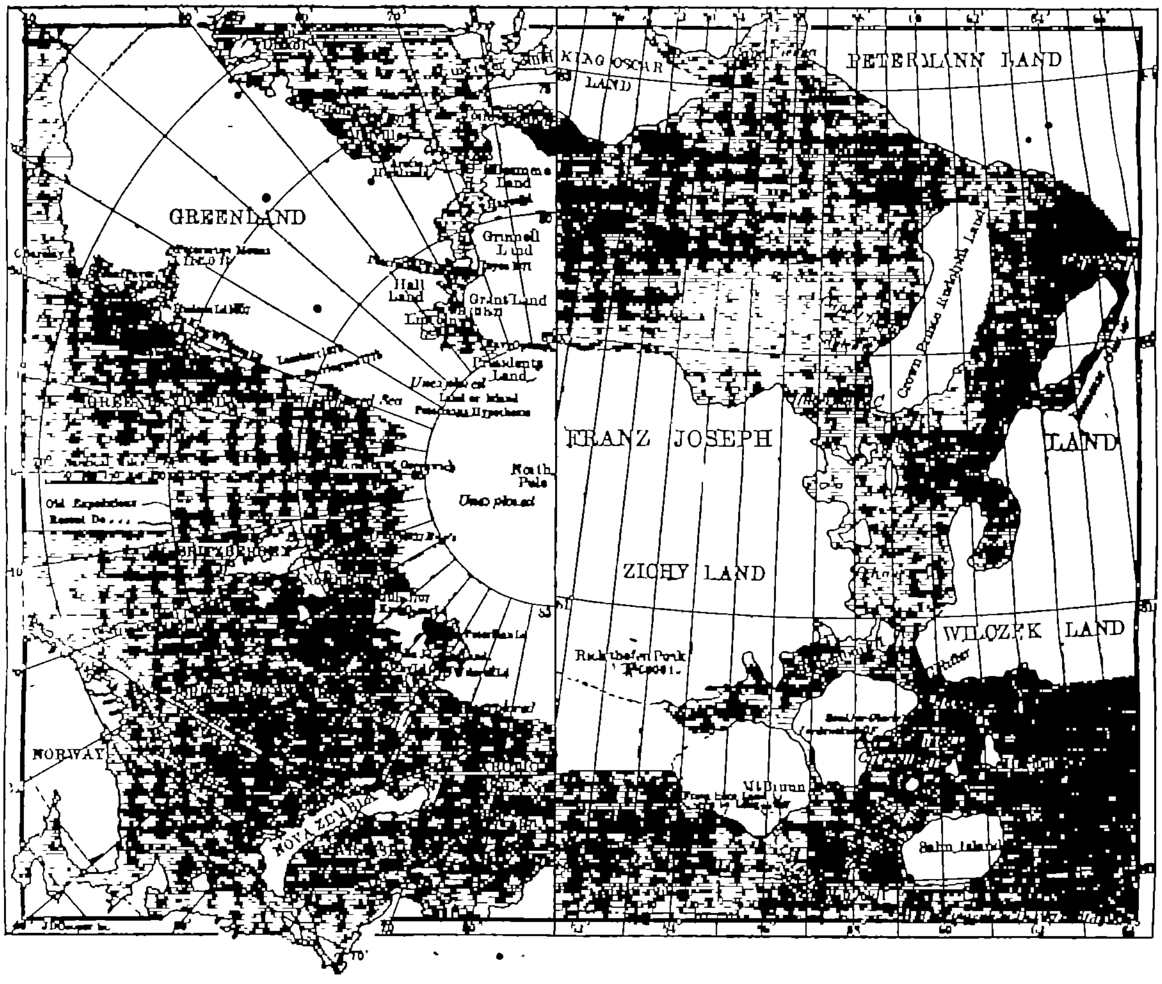
No general with his victorious army returning from battle could have been welcomed with greater enthusiasm and cordiality than this little band of twenty-two men. For though they only come home from a North Polar expedition, people instinctively feel that the accomplishment of the *Tegetthof's* voyage is a heroic deed. To gain a battle, hetacombs of precious human lives must be sacrificed; here all came safely back. A battle does not demand greater endurance and courage, for the battle of the *Tegetthof* lasted two years. We think of the times of Columbus and Vasco da Gama, of their discoveries and return to Palos and Lisbon. It is true the Austrian expedition did not find an America or an India; but Columbus, and other great discoverers, did not really discover more than Weyprecht and Payer. Before Columbus traversed it, men believed that the western ocean was not navigable, and similar ideas prevailed with more reason concerning the sea just explored. One of the first describers of polar regions, Scoresby, had, in the year 1820, in his famous work, drawn a line over the whole sea from Bear Island, in 74½° N. lat., to Novaya Zemlya, and said, with confidence, "Here is the icy barrier where navigation must end;" and the unknown regions beyond this line were regarded by mariners with pious dread. The Austrian expedition has torn away the veil up to 83° N. lat., and has narrowed the undiscovered parts of the earth by a space of 8° to the north.

They had to stay at Novaya Zemlya for four weeks, and work their way out of thick ice for at least 240 geographical miles before reaching Cape Nassau, which was the starting-point of the expedition. They then encountered the most terrific dangers which can befall a polar expedition, for they were hemmed in by an ice floe, and shut up for fourteen months in pack ice, and driven about in the Siberian icy ocean. Eventually a tolerably safe place in the open ice was found for the second wintering, when the crew heroically divided themselves, the better to explore the land they had discovered.

The comrades of the *Tegetthof* have shown themselves worthy to take rank with their prototypes, Ross, Parry, M'Clintock, Kane, Hayes, and Hall, for they have made a breach in a place where no one since Barents, during all the 300 years of arctic discovery, had attempted an attack. The explorations are here shown on a map constructed from the original preliminary sketch by Payer, with the geographical constants drawn by Dr. Petermann.'

The nature of the North Pole is not so fully known but that the learned world is still fighting as to whether it is land or water, or an everlasting ice-cap, stretching like our home glaciers, or obeying other laws, or dissolving and opening under the influence of the warm sun, air, or water, like our own seas. And since any expedition can only discover a proportionally small part of the great unknown arctic world, there will always be some people ready with ape-like wisdom to 'pronounce against any endeavour to unfold the laws of nature within the inner polar regions. Dr. Petermann has for ten years urged that Germany should send out a polar expedition far into the great European polar sea, and is particularly anxious to get the whole breadth of the European North Sea explored from East Greenland to Novaya Zemlya, north of Bear Island.

The results of this expedition have marked an epoch in various ways. First by the drift for fourteen months in the ice-floe. Such driftings have occurred before on a larger scale, as in the case of De Haven, M'Clintock, the *Hansa* people, and the *Polaris* people; but all these expeditions drifted south--the *Polaris* crew from 80° N. lat. to 53°. But entirely new and full of significance for physical geography, is the circumstance that the path of the Austrian expedition was uninterruptedly towards the north.



The map on the left shows the state of polar exploration up to the end of September 1874; that on the right is the newly-discovered land.

The following instances also show that the icy sea is navigable. Hall's expedition north from Smith's Sound proved that from Tessiusak in 73° 20' N. lat., through the ill-famed Melville Bay, Smith's Sound, Kennedy Channel, Robeson Channel, to 82° 11', was reached with ease in eleven days, the distance being more than 700 miles; and the best officers of this expedition declare their united conviction that they could easily have reached further north. The Karis Sea, formerly called the Ice-cellar of the North Pole, has proved to be completely navigable. Admiral Sir E. Parry, after Sir James Clark Ross perhaps the most experienced of all polar travellers, going north from Spitzbergen, came to the conclusion that a ship might sail to 82° N. lat. without encountering a piece of ice. Admiral Beechey, one of the most excellent and perhaps the most scientific sea captain who has ever lived, said in 1831 that he considered the navigation of the coast of the arctic region as practicable.

Dr. Petermann then asks: Is the experience of the Austrian expedition a measure of the resistance offered by the ice in the icy sea just explored? Are all the results which are opposed to it, from the former expedition of Weyprecht and Payer, not worthless? Is it worth nothing that numerous Norwegian fishermen in sailing boats have been able to sail round Novaya Zemlya since 1869 and penetrate far into the Siberian ice sea, always finding it navigable and quite free from ice? Is it not worth remembering that at the time Payer and Weyprecht found the unwonted accumulation of ice by Novaya Zemlya, the western half of the great sea, *quite against the rule*, was free from ice, so that the Norwegian fishermen were able for the first time to reach the mystic Gillisland, which is King Charles Land? Under certain unfavourable conditions of wintering, the north side of Novaya Zemlya is, without doubt, as difficult and impossible for navigation as the north side of Spitzbergen, or Cape Horn, or the Cape of Good Hope, or the English Channel, or the mouth of the Weser.

The *Tegetthof* is a small steamer of 220 tons, and though her supply of coal was necessarily small, it proved ample, for steam could only be got up three times in the first three weeks of the voyage. And thus, as in all recent voyages, rowing boats proved themselves better fitted than steam launches for exploring work. In the summer of 1872, the journey from Cape Nassau could not be made in a straight course, but Count Wilozek's journey in the sailing vessel *Isbjörn* demonstrated that it was practicable by following a tortuous course.

The best and first account of the results of the Austrian expedition, in relation to their bearing on the present state of knowledge of arctic geography, and of the current setting into the icy sea from the south, is given by Dr. Joseph Chavanne, and is as follows:—

"The rising polar sun of 1874 lighted up and discovered a new land, now named Franz Joseph Land, and the expedition set off to explore it in sledges. They found the country to be a narrow, far-extending foreland, divided from Greenland by a wide arm of the sea now named Austria Sound. It is mountainous, approaching to a plateau, with steep conical mountains 5,000 feet high, covered with enormous glaciers. This newly discovered land stretches for more than 15° of longitude, and bounds the horizon with mountains as far as the eye can carry to the north and west. In 83° N. lat. they sighted Cape Vienna, the most northern point visible, and Cape Pesth, one degree further south, and finding the great glaciers impassable in this latitude, they returned to their icebound ship. Imperative necessity compelled them to abandon their vessel upon its icy platform, and they set out to return to Europe with four sledges. They travelled on for sixty-nine days, and then fell in with the Russian schooner *Nikolai*, who landed them at Vardoe, in the north of Norway. Austria Sound, and other fjords, were filled with icebergs. They met with no trace of human inhabitants, and remark that animal and plant life is scarce and small in the south."

Twenty-two years ago Dr. Petermann indicated on a map of the arctic regions the polar extension of the Gulf Stream. Though generally regarded at the time merely as the hypothesis of a German philosopher, the unwilling drifting of the *Tegetthof* in the ice has proved that the principal northern branch of the Gulf Stream washes the west and northern coast of Novaya Zemlya. Between the west coast of Novaya Zemlya and the east coast of Spitzbergen, enormous masses of ice press westward with the polar current flowing from New Siberia Island and the Siberian rivers, and penetrate wedge-like into the Gulf Stream. The temperature of Franz Joseph Land in the winter of 1872-73 was 40° Réaumur.

The remarkable correspondence between the coasts on the two sides of Greenland supports the conjecture that the polar land, if not subdivided into a number of islands by ramifying arms of the sea, is at least deeply indented by fjords, as is demonstrated by Hall's discovery of Petermann's Fjord on the west coast of Greenland and Franz Joseph's Fjord on the east.

PHYSICS AT THE UNIVERSITY OF LONDON*

II.

TURNING then first of all to the Regulations for Matriculation in the University of London, we find that the knowledge of Physics that is required is specified under four heads: namely, *Mechanics; Hydrostatics, Hydraulics*, and *Pneumatics; Optics;* and *Heat*, which last, until quite recently, was included in the examination in Chemistry; and the whole is accompanied by a general qualifying note to the effect that "the questions in Natural Philosophy will be of a strictly elementary character." The particulars, which are given under each of the above general heads, read as if they might have been copied, as they stand, from the table of contents of an elementary treatise on Natural Philosophy published about a hundred years ago. I have examined them often and carefully, and have never found a tittle of internal evidence to show that they were drawn up within the present century; and yet we know that they are the work of a University, not yet forty years old, which owes its very existence to the demand for educational progress, and began its career—without indeed the wealth or the prestige of its older compeers—but also without the trammels of tradition and ecclesiasticism, which render it so difficult for them to advance with the times. It is not a sufficient defence of the antiquated character of these Regulations to say that the very nature of the examination to which they refer would make the introduction of new discoveries entirely out of place, and that, in point of fact, the fundamental doctrines relating to the subjects in question were as fully established a hundred years ago as they are now. This is so nearly true (except in the case of *Heat*), that it would not be worth while to dispute it; but my objection is not to the want of novelty in the subjects enumerated, but to the want of perception, which the manner of the enumeration indicates, of the possibility of progress or improvement in the ways of teaching long-known truths. Instead of giving prominence to general principles in such a way as to suggest to teachers the use of easy and comprehensive methods, these Regulations cut up the subjects to which they relate into a number of detached propositions, of greater or less generality, which teachers and students, who accept these Regulations as their guide, generally treat as independent units of knowledge each of which is to be put into a separate hole of the memory. It would be wearisome, but not difficult, to illustrate my meaning by particular examples; the substance of it is that this examination does not encourage good teaching of the elementary parts of Physics, but induces candidates to trust to memory almost to the total exclusion of any attempt at thinking. My opinions on this subject have not been formed *à priori*, but have been forced upon me by reading examination papers, and by trying to teach in what I believed to be the best way. It is in general nearly hopeless to try to get students, who have the fear of the London Matriculation Examination before their eyes, to make any serious attempt to understand the principles of Mechanics; but they often show a lamentable willingness to learn statements of them by heart, and when they go up for examination they know a great deal and understand next to nothing. They know that in a lever of the first kind, whose weight is neglected, the power is to the weight as the weight's arm to the power's arm; that when a heavy body falls from rest, the spaces described in successive seconds are as the natural series of odd numbers; and they are ready at the shortest notice to write down the formula for calculating the specific gravity of a solid body heavier than water; but it is only in the rarest possible cases that they can be got to reproduce the reasoning by which these results are connected with general physical principles. The industry displayed in acquiring separate fragments of information about Physics is often extremely creditable; but it is impossible not to regret that the same method should be employed in learning what is called Science, as in learning the dates of accession of the Kings of England.

---

* Introductory Lecture delivered at the opening of the Session of the Faculties of Arts and Laws and of Science, in University College, London, on Monday, Oct. 5, 1874, by G. Carey Foster, F.R.S., Professor of Physics. Continued from p. 508.

A still more curious instance of the antiquarian tendencies of the University of London is afforded by the Regulations for the Degrees in Science, which were instituted as recently as 1860. It might have been supposed that when the Senate had once determined to make so great an innovation in the traditional usages of English Universities as to grant Degrees in Science, they would have been impelled by the spirit of their own act to frame such regulations for the examinations as should be in full agreement with the present state of science. I recognise as fully as anyone the impropriety of introducing anything that can fairly be called a new discovery into examinations such as those for the London degree of Bachelor of Science, but between such a course and that adopted by the University there is a very broad *via media*. In order to obtain the degree of Bachelor of Science, a candidate requires, after Matriculation, to pass two further examinations, called respectively the First and Second B.Sc. Examination. At the former, a paper is set in what is called "Mechanical Philosophy," and another in "Natural Philosophy," the Mechanical Philosophy being a repetition of the subjects called Natural Philosophy at Matriculation, with a few additions, chiefly under the head of Optics, while the Natural Philosophy includes *Heat*, *Electricity*, and *Magnetism*. At the Second B.Sc. Examination there are two papers in "Mechanical and Natural Philosophy," which are explained by the Regulations to mean nearly the same parts of Statics, Dynamics, Hydrostatics, Pneumatics, and Geometrical Optics as those prescribed for the First B.Sc. Examination, but treated a little more fully, and with the addition of a very little Acoustics, a little Physical Optics, and a smattering of Astronomy. The details given in the Regulations under each of these general heads are open to the same general criticisms as those which I have already ventured to make upon the mode in which the requirements in Natural Philosophy are stated in the Regulations for Matriculation; in fact, those parts of the subject which are common to the three examinations are specified in very nearly the same words in each case, the difference being that a slightly more mathematical treatment of them is expected at the higher examinations. In each case there is the same failure to suggest general and comprehensive points of view, and the same enumeration of particular examples, as though they were of equal importance with the general principles which they illustrate. It is just as if, in an examination in Latin or Greek, instead of its being stated that candidates would be required to answer questions in grammar, lists of particular nouns and verbs were given with the announcement that candidates might be required to give the declensions or principal parts of any of these. But these Regulations are defective not only in form but in substance—not only in spirit but in matter. Without going into further details in order to justify this statement, I may mention, by way of illustration, that at the First B.Sc. Examination, under the head *Electricity*, there is no distinct reference to any of the quantitative laws of the science, and it is only by a laxity of interpretation quite unsuited to the subject that an obscure allusion to Ohm's Law can be discovered—the great law expressing the connection between the strength of an electric current and the nature of the circuit which it traverses; while, under *Heat*, no liberality of interpretation could detect the smallest trace of the Dynamical Theory of Heat. This last omission, however, ceases to be surprising when we find the steam-engine classed with the common pump and forcing-pump; the hydrostatic press, the barometer, and the air-pump, under *Hydrostatics*, *Hydraulics*, and *Pneumatics*. It might have been natural a hundred years ago to look for Newcomen's atmospheric engine among such company; but, even then, James Watt had nearly converted the old atmospheric engine into the modern steam-engine.

But there is no need to enter upon any minute investigation of the Regulations for these examinations, in order to be convinced that their effect upon the study of Physics must be unfavourable. The small amount of encouragement which they hold out to pursue this subject seriously is shown by the fact that a London Bachelor of Science is not required to have any more knowledge of heat, magnetism, or electricity than candidates for degrees in Medicine are required to show at the "Preliminary Scientific (M.B.) Examination," which, in the usual course of things, is taken one year after Matriculation; and also by the fact that the papers in Mechanical and Natural Philosophy set at the Second B.Sc. Examination are identical with those set in the same subjects at the Second B.A. Examination. I have no fault to find with one side of this last arrangement; I have already given reasons for considering that Physics ought to occupy an important place in general education, and, from this point of view, the physical subjects for the Second B.A. Examination are, on the whole, not injudiciously chosen; but it is certainly strange that a degree in Science should not imply any greater acquaintance with the fundamental principles of Mechanics than is demanded of candidates for the degree of Bachelor of Arts, the examination for which is in the main literary and classical. Another fact, which may be regarded as a sort of experimental proof that the examinations of the University of London do not promote such a study of the elements of Physics as can serve as the foundation for a more advanced study, is that for the last five years a special examination for Honours in Experimental Physics has been held in connection with the First B.Sc. and Preliminary Scientific (M.B.) Examinations, at which a Medal and a Scholarship of 40*l*. a year, tenable for two years, are offered to the most deserving candidate in case of his exhibiting sufficient absolute merit, but hitherto the scholarship and medal have never been awarded, and only once has a candidate obtained a First Class at this examination.

The other examinations of the University of London into which Physics enters to a greater or less extent, are, that for the degree of M.A. in Branch II., and those for the degree of D.Sc. in certain branches; but as these examinations come at a stage of a man's career at which it may be supposed that his methods of study are not greatly influenced by the regulations of examining bodies, and as, moreover, the Regulations of the University relative to these degrees do not go much into detail, there is no reason for dwelling upon them in connection with my present subject.

I do not propose to say much about that part of the examinations for which the Examiners, rather than the Senate, are directly responsible; but there are one or two considerations which, although sufficiently obvious, it may be worth while to point out. First of all, however, I shall venture, presumptuous as it may be thought, to make one remark on the choice of the persons best fitted to be examiners. It has more than once been claimed as a special merit of the University of London, that the examiners are not teachers, or at least that they have nothing to do with teaching the candidates whom they are called upon to examine. Fortunately, however, this is not the case. As a matter of fact, the great majority of the examiners are always teachers, and it may quite well happen, at least at some of the smaller examinations, that a majority of the candidates have been pupils of a single examiner. But I venture to think that, instead of this state of things being considered as a more or less regrettable accident, it ought to be recognised as natural and desirable. If the real object of the examinations be to promote good teaching and sound learning, it is most important that, in setting the questions, the examiners should always keep in view their probable effect in giving direction to the studies of future candidates; and there can be no doubt that the men who are both most likely and most able to do this are those whose constant business it is to consider how the subjects in which they have to examine can be best brought before the minds of learners. Moreover, it is very difficult for examiners who are not also teachers, and teachers accustomed to pupils who are at about the same stage of advancement in their studies as the majority of the candidates, to know what amount of knowledge it is reasonable to expect. A man, however minute his own knowledge of his subject may be, generally soon forgets the exact steps by which he acquired it; and, unless he is in frequent contact with the minds of learners, he is no longer able to tell what, at any particular stage, it is creditable to know, and what it is disgraceful to be ignorant of. And again, though this perhaps is a less important consideration, the necessity which a teacher is under of periodically reviewing the whole round of his subject, is a great help towards a varied selection of questions.

With regard to the particular kind of questions which are most desirable in examinations like those of the University of London, I wish to say only a very few words. If the general considerations to which attention has been drawn in an earlier part of this lecture are of any value, it follows at once that examination questions in Physics ought to be selected with a view to testing the reasoning power and not the memory of candidates. If what are called *book-work* questions are admitted at all, they should be such as will bring out the power of reproducing trains of consecutive reasoning, and bringing facts to bear on the establishment of general conclusions, and not the power of simply recollecting individual facts. It may be said that such questions would be unfairly difficult. I can only say in reply that, if teaching were what it should be, I do not believe that this would be the case; but if it should be found to be so, I maintain that the inference is, not that any other style of examining in Physics should be adopted, but that the whole subject should be dropped. A late very distinguished member of the University once said that, in the case of candidates for Matriculation, all that could be fairly required at the examination in Physics was evidence of "correct acquisition." It would in my opinion be only a little more absurd to say that all that ought to be required at an examination in Geometry is evidence of the "correct acquisition" of Euclid. If Physics is not a subject upon which the intelligence should be exercised from the very beginning, it seems to me to be a waste of time to teach it at all.

The consideration of the kind of questions that are best fitted to be of use in promoting improved methods of teaching and learning, suggests a remark which bears upon the distinction that has often been pointed out between the subjects which it is desirable to teach and those which are most suitable for examinations. In the particular case of Physics, I am inclined to think that the very elementary parts of such branches as Heat and Electricity are not well adapted to form the subjects of examinations like those we are considering, where the examiners have no means of knowing the exact points of view from which the matters dealt with have been presented to the candidates. My reason for this opinion is the difficulty in these subjects of setting questions which require anything more on the part of candidates than mere exercise of the memory, and which at the same time are not unreasonably hard. As a practical inference, it appears to me that, if the amount of acquaintance with Heat, Electricity, and Magnetism represented by the London Regulations for the First B.Sc. Examination (supposing the regulations to be strictly interpreted) is all that can be fairly demanded at this stage of a student's progress, it is at least a question whether these subjects should not be deferred until a more advanced stage, when something more than descriptions of apparatus or the solution of arithmetical problems might be reasonably required.

If any of my audience have listened to this lecture with the consciousness that they will soon be going up to one or other of the examinations that I have been discussing, it may very possibly seem to them that I have been pleading throughout for making these examinations more difficult. To any to whom this seems to be the tendency of my remarks, I would venture to suggest one or two further considerations. In the first place, I fully admit that if examinations in Physics were to be such as I have advocated, that is, if they required candidates to *think*, while the teaching of Physics remained what too much of it now is—a mere loading of the *memory*—candidates would, no doubt, have a hard time of it; but the whole intention of what I have said is that examinations should be improved *in order* that teaching may be improved through their influence; and I believe that if teaching were what it should be, good examinations would be found to be no more difficult than bad ones. I may also observe that after all the precise degree of difficulty which an examination presents is not the most important consideration even for an intending candidate; what it really is important, not only for candidates but still more for those who regulate examinations, to consider is, what is the permanent educational value of the work which an examination requires, and not simply what is the amount of work needed. I have many a time in reading examination papers felt sincerely sorry for the writers when I saw how much labour they had evidently gone through in order to learn nothing—nothing that is of real use—and have thought how much the same amount of labour might have accomplished if it had only been better directed; and I beg leave to assure any who look upon examinations from the under side, that I have no wish whatever to add to the quantity of work that is already required of them; but what I do wish sincerely is, that whatever work they may be required to do in preparing for examinations may be such that they will be intellectually better and stronger for having done it. It cannot be too often repeated that degrees and university distinctions are of no more value in themselves than the Queen's head upon the coin. unless the metal is genuine, the stamp only makes it into a lying counterfeit. This has been urged upon students over and over again; what I shall be glad if this lecture tends in any degree to accomplish, is to press the same truth upon the attention of our University authorities. It is important for them to remember that a man is not really either better or worse for all the degrees that they can give him; and that their boast should be, not in the length of their lists of graduates, but in the extent to which they have promoted "a regular and liberal course of education."

NOTES

ONE of the first results of the Transit of Venus expedition with regard to the geological aspect and vegetation of a comparatively little known island, comes to us from Rodrigues, and is contained in a communication from Mr. J. B. Balfour to Dr Hooker, under date, from the above island, of August 23, 1874. As a proof of the inhospitable, or rather the uncivilised nature of the island, it is stated that the party belonging to the expedition were warned in Mauritius before starting for Rodrigues that they must take everything from the former island that they would be likely to require as it would be impossible to get anything at Rodrigues, and even labour is most difficult to be obtained. After providing himself with various articles of absolute necessity, Mr. Balfour started from Mauritius, and after a voyage of exactly a week, landed at Rodrigues on August 18. The appearance of the island as seen from the vessel while steaming along near the coast, presented few features which could be looked upon as evidencing any large amount of granite entering into its constitution. On the contrary, the columnar structure of the cliff lines, both on the coast and in the interior, along with the terraced aspect of many of the ridges separating deep ravines, cutting far back into the island, clearly showed that, whether the main mass of the island were granite or not, certainly at some period of its history it had been the scene of very extensive volcanic action. On the 19th of August an excursion was made across the island to survey the channel on the south side. The vegetation on the island is very rank. The trees do not grow to any great size, and in most places do not form thick forest, but are scattered singly over the slope of the hills. It is only in the deep valleys and gorges that they grow into thick forest. The commonest tree seems to be the Vacoa (*Pandanus*), of which there are probably at least four species. The under-scrub is very dense and very spiny, which renders walking through it by no means a pleasant task. Neither ferns nor mosses appear to be very abundant, but lichens are pretty plentiful, especially in their pulverulent state; and in many places the basalt was nearly covered with white powdery patches. The basalt forming the rocks near Port Mathurin is, in its unweathered condition, a very beautiful compact stone, with large crystals of several minerals scattered through it. The difficulties in landing upon the island seem to be very great, owing to the extent of the coral reefs.

THE Yorkshire College of Science at Leeds was opened without ceremony on Monday, by the delivery of one of the introductory lectures by Mr. A. H. Green, the Professor of Geology and Mining. The other professors—A. W. Rücker, Dr. T. E. Thorpe, and W. Walker—give their introductory lectures during the course of the present week, and the teaching of the session will then be proceeded with. Very suitable buildings have been obtained, containing ample accommodation, which has been fully utilised for lecture-rooms, laboratories, &c., which are well furnished with the necessary appliances. Still, as Mr. H. Brown said, "they must look forward to having a noble building like that of Owens College, Manchester;" if the College is to maintain its position and to advance at all, it cannot but end in this. The number of students enrolled is as yet small, but, no doubt, will gradually increase. Prof. Green, in his address, spoke of the importance of a thorough training in abstract science as the necessary groundwork of a technical education. "Before they could understand," he said, "the practical application of a science, they must be master of the science itself. What was sometimes understood as technical education was a sheer impossibility, and a contradiction in terms. They could not explain the technical application of a science without first laying down the scientific groundwork on which it rested. A science like geology could not be taught piecemeal. Technical education in the popular sense was a misnomer, because the teaching which would limit the range of a man's vision to the subjects of which he could see the use did not deserve the name of education, the very essence of which was the strengthening of the intellect by mental exercise. It was his earnest wish that he might be able to give a teaching which in the end would have an important bearing on their practical occupations, and enable them to manage their mining, engineering, and other pursuits—in the conduct of which a knowledge of geology came in useful—better than if they knew no geology at all. But if he was to succeed in doing so, he must begin by telling them many things which at first sight would seem to be of no practical value whatever." With such a spirit as these words indicate, animating the professors of this new college, the best results may be expected from their teaching.

A MEETING of some of the friends of the late Dr. Stoliczka was held in the rooms of the Zoological Society on Friday, the 16th inst., at which it was determined to obtain, by subscription, a bust, to be presented to the Asiatic Society of Bengal, of which society Dr. Stoliczka was for some years before his death one of the honorary secretaries. A committee was appointed to act in concert with one previously formed in Calcutta, and upwards of 50*l*. was subscribed in the room for the purpose mentioned. Subscriptions, we are informed, will be received by Messrs. Grindlay and Co., 55, Parliament Street.

THE *Athenæum* announces that the *Contemporary Review* for November will contain an account of a new scientific discovery by Prof. Tyndall.

AMONGST the works which are progressing favourably at the Observatory of Paris we may mention the determination of the velocity of light, by MM. Fizeau and Cornu. These able physicists are using for their second station the Tower of Montlhéry. The light is transmitted to Montlhéry through a refracting telescope of 12 in. and returned to the Observatory with a 7 in. The distance between the Observatory and Montlhéry being 26 kilometres, the total distance traversed by the ray of light is 52 kilometres. The space of time required amounts to something less than one-thousandth of a second.

THE polishing of the great reflecting telescope is almost completed, The immense lens to be covered with silver by the Leon Foucault process, is nearly ready. It is said that everything will be finished by the beginning of May 1875.

AT Agram, the chief town of Croatia, a Croatian University was formally opened on Oct. 19 by the highest magistrate of the land, who is called the Ban, and exercises a kind of viceregal power on behalf of the Emperor of Austria. The University is to be called "Francis-Joseph," from the name of its founder. The Rector delivered a very able oration, summarising the progress of the higher studies in Croatia from the time when Maria Theresa established the Society of Sciences. Many delegates of foreign or other Austro-Hungarian Academies were present at the ceremony (Krakow, Berlin, Bologna, Pesth), and delegates from the Servian societies of learning. It is expected that the new University will play a most important part in the civilisation of the East, and be indeed the vanguard of European science in that direction.

MUCH remains to be done in this respect if the information we collect from Levantine papers be correct. It appears that in one of the principal islands of the Greek Archipelago some poor women have been imprisoned and starved, under the charge of sorcery. They were arrested for having attracted a host of locusts to their native land. The locusts not retreating, the persecution was extended to the husbands of the wretched creatures.

THE International Commission of Geodesy will hold its next meeting in Paris, in accordance with the decision come to at Dresden, where it held its sitting this year. The Government will assign it a public building for its meetings.

MR. J. E. TAYLOR, F.G.S., has discovered a buried forest in the Orwell. The forest is represented by a layer of peat containing trunks, leaves, and fruits of the oak, elm, hazel, and fir, associated with which are the remains of the mammoth. A bed of freshwater shells containing species not now living in the Orwell underlies the peat. Mr. Taylor remarks that this submarine forest is contemporaneous with others along the coast which existed previous to the depression separating England from the Continent.

MR. J. E. TAYLOR, who has done so much to create an interest in science in Ipswich, is to give a course of twenty lectures (free) in that town during the coming winter, on "Plants: their Structures and Uses."

AN important discovery has been made at Highwood, near the village of Ashill, in Norfolk, consisting of a vast collection of Roman remains in an oak-lined well, 40 ft. deep. The Norfolk and Norwich Archæological Society visited the spot on the 16th inst., when the well, under the superintendence of Mr. Barton, was emptied of its contents by a number of workmen. The well contains a great variety of articles, the most abundant being urns, of which about 100 have been obtained; more than fifty of these are perfect, and many of most beautiful form and ornamentation. There is considerable doubt as to the purpose which these wells were intended to serve; there are other two at Ashill, and others have been found elsewhere.

THE *New Quarterly Magazine* for October contains, with other articles of general interest, a paper by Mr. Richard Jefferies on "Small Farms." The writer notes the enormous development of science in modern farming, saying: "New plans, new inventions and discoveries follow each other in constant succession. The capabilities of agriculture seem inexhaustible. The number of clever and intellectual men who turn their attention to it multiply daily. It has its colleges, its professors, its students, and it would require a great volume to describe the machinery alone that has been contrived of late years, and is now in the market. The chemistry of agriculture would fill many more such volumes. Geology, botany, entomology, almost all the sciences, are pressing forward to its aid." Deprecating, in the present state of agricultural science, the advantages of small farms, Mr. Jefferies goes on to say: "The utility of bringing up a race of students instructed in chemistry, geology, entomology, mechanics, &c., in agricultural colleges, with the assistance of professors, if they are afterwards to be placed on small farms, is a matter of much doubt; they would have no room for the exercise of their attainments. . . . Whether it be considered from the tenant's own side, or from the labourer's, or from the landlord's, the balance of argument appears to be indisputably in favour of large farms. To the nation, to the ever-increasing population, the large farm offers a greater present produce, and possibilities of still further development. The political economist, who judges the prosperity of an occupation by the amount of capital attracted towards it, must also decide in its favour, for capital will never flow into small farms."

WE commend to the notice of the Goldsmiths' Company the letter from "A Jeweller's Assistant" in yesterday's *Times*. Let us hope that this, as well as the other wealthy City Companies, are now waking up to a sense of their responsibilities, and that they will lose no time in utilising the immense wealth at their disposal, and which has hitherto been utterly wasted, in the promotion of technical—which ultimately means scientific—education. Let them not provoke a "City Companies' Commission."

ON the 12th inst. was opened the London School of Medicine for Women. The Council had determined that no inaugural address should be given, and thus a day which the future may possibly prove to have been one of no little importance passed by unmarked more than by the fact that the first lecture had been given in a Medical School devoted exclusively to the teaching of the female sex. The school is now in full working order, and women can receive an education fitting them to practise medicine. The services obtained by this school need not stop short at preparing women for the medical profession. There are many branches of science allied to the study of Medicine, Chemistry, Botany, Comparative Anatomy, &c., in all of which a course of lectures is given as part of the medical education. These subjects are separately adopted by men as a means of gaining a livelihood. A knowledge of any one of these subjects is attainable equally by women as by men, and there is no reason why women should not achieve a scientific reputation and earn a fair competency by engaging in these studies and by imparting their knowledge to others.

IT is announced by the last Indian mail that a smart shock of earthquake was experienced in Central Ceylon early on the morning of the 19th of September, at five o'clock. The vibration was considerable, and was accompanied by a dull rumbling sound. The motion was from east to west, apparently; the rumbling was decidedly in the east. The shock appears to have been felt in the centre of the island only. Earthquakes in Ceylon are such rare events that this one has had a good deal of attention bestowed upon it.

WE would draw the attention of our readers to the excellent introductory lecture delivered by Prof. Leoni Levi at King's College, on "The Educational and Economic Value of Museums and Exhibitions," which is published in the *Society of Arts Journal* for the 16th inst. He gives many valuable suggestions as to the uses for purposes of popular teaching which might be made of our museums. He thinks that London is still deficient in museums, and states that there are at least some two hundred cities and boroughs which have taken no step to secure museums and public libraries for themselves.

THE *Augsburg Allgemeine Zeitung* of the 22nd inst. gives the following facts and statistics from the various University Calendars just published:—The University of Berlin shows the largest attendance, having had, in the summer term of 1874, 2,980 students and 187 professors. While this University had for a time the second place and Leipzig the first, the order is now reversed, and Leipzig follows with 140 professors and 2,800 students. Then comes Halle, with 1,055 students and 95 professors; Breslau, with 1,036 students and 107 professors; Munich, with 1,031 students and 114 professors; Tubingen, 921 students and 84 professors; Wurzburg, 901 students and 58 professors; Heidelberg, 884 students and 104 professors; Bonn, 858 students and 98 professors; Strassburg, 667 students, and 81 professors; Konigsberg, 603 students and 76 professors; Greifswald, 540 students and 58 professors; Jena, 493 students and 69 professors; Munster, 451 students and 27 professors; Erlangen, 442 students and 51 professors; Marburg, 440 students and 62 professors; Giessen, 342 students and 58 professors; Freiburg, 297 students and 52 professors; Kiel, 210 students and 62 professors; Rostock, 132 students and 38 professors. In these numbers the non-matriculated students are also included. The German-speaking Universities outside the German Empire show the following attendance:—Basle, 163 students and 62 professors; Berne, 332 students and 63 professors; Zurich, 331 students and 75 professors; Dorpat, 768 students and 67 professors; Graz, 932 students and 68 professors; Innsbruck, 615 students and 52 professors; Prague, students (?) and 122 professors; Vienna, 3,615 students and 227 professors. Vienna, therefore, is at the present time the largest German University.

M. HURQUERLOT, a gentleman who was largely interested in railway speculations, died a few months ago and left a legacy of 24,000*l*. to the city of Paris for the purpose of establishing a railway school. But the sum, although very large, having been considered insufficient for the purpose, the Municipal Council has been reluctantly obliged to reject the money, which will revert to the lawful heirs.

MORE than 18,000 young men have gone successfully through their examinations, and have been admitted as volunteers for one year in the French army. About half of that number have been rejected as not having received a sufficient education. The report of the examiners shows an improvement in the mean capacity of candidates. Many young men are admitted, without having to pass previous examinations, Bachelors of Arts, Sciences, or Letters, Pupils of Public Schools of Arts and Public Works and Mines, and Beaux Arts, and a few other institutions. The number of the volunteers of that class is about 4,000. Each volunteer has to pay besides a sum of 60*l.* to the Government. Education must be combined with money, in order to shorten the service in the remodelled French army.

THE study of "seaweeds" is probably affected as much by the general public as that of fish; and whether or not the great mass of people who visit the Brighton Aquarium and other similar resorts really go there with any idea of becoming more intimately acquainted with the wonders of the deep, there is no doubt that the exhibition of varieties of ocean plants would be as popular as that of fish. A seaweed growing in water is very different from seaweed cast up on the shore, and a careful selection and arrangement of specimens would greatly enhance the interest of the tanks, whilst at the same time their presence would prove beneficial to the fish. We recommend the hint to the notice of the authorities of the Brighton, Crystal Palace, and Southport Aquariums.

AN Industrial Exhibition is to be held at Leighton Buzzard for a short time about Whitsuntide 1875. The district to be represented is limited to a radius of twenty miles around Leighton Buzzard, and the proceeds of the exhibition will be devoted to the formation of a lecture fund for the purpose of securing courses of high class (largely scientific, we hope) public lectures in connection with the Working Men's Society, and the increase of the Society's library.

To increase the general instructiveness of their Museum, the Leeds Philosophical and Literary Society have published Descriptive Guides to the different collections of which it is composed. That on the British Birds, by Mr. L. C. Miall, is before us, containing a short and instructive account of each species exhibited. This method of combining instruction with amusement is one which it would be well if other public institutions were to adopt, instead of leaving their collections, often valuable ones, for the idle gaze of the many uninitiated, and the careful study of the but too few special students of special branches of science and art.

IN many parts of the coasts of this country where fish are abundant, enormous quantities are used as manure: in Cornwall and on the Eastern coasts this is particularly the case, but no means are adopted to convert the fish into a manufactured manure, and they are thrown, as caught, on the land. The same remarks apply to America. But recently a system has been adopted in certain localities by which the fish are prepared specially for manuring the land. At Lucages, Long Island, a factory has recently been established for preparing the surplus quantities of "Menhaden" caught near there. The oil is first extracted from the fish, and the residue is prepared in a certain manner and converted into "fish guano," which has a good reputation as a fertiliser.

ARRANGEMENTS have been made for placing on board one of the steamers running between Liverpool and New York, one of the "American Aquarium Cars," a newly invented contrivance for transporting live fish, which has succeeded very well in long overland journeys, and by means of which it is hoped to effect a useful interchange of living fish of various kinds between this country and America. There are many American fish which might with benefit be introduced into England, and we at the same time might transport to the other side of the Atlantic some varieties of fish which are not found there.

THE exhibition of insects in the Orangery of the Tuileries Gardens, Paris, has been brought to a close. The distribution of prizes took place on October 5. The higher medals were taken by a Viennese *savant* for a magnificent atlas exhibiting all the organs and forms of *Phylloxera vastatrix*; but the Phylloxera question is left open, and no reasonable solution appears to have been presented. Lectures were delivered daily on entomology, and every one of them was illustrated by projections with the solar microscope. Almost every kind of insect was thus presented to the public. The exhibition proved wonderfully successful; more than 20,000 persons paid the entrance fee, and the number of free tickets issued amounted to 30,000 in the brief space of twelve days.

WE have received a lecture on "The Life and Works of Dr. Priestley," delivered in Paris at the time of the celebration of the Priestley Centenary by M. W. de Fonvielle. It is published by Auguste Ghio, and is dated 1875.

THE additions to the Zoological Society's Gardens during the past week include a Bengalese Leopard Cat (*Felis bengalensis*) and a Common Paradoxure (*Paradoxurus typus*) from India, presented by Capt. W. Reynolds; a Great Eagle Owl (*Bubo maximus*), European, presented by Lord Londesborough; an Indian Fruit Bat (*Pteropus medius*) from India, presented by Dr. Stafford; a Monteiro's Galago (*Galago monteiri*) from Angola; a Tooth-billed Pigeon (*Didunculus strigirostris*) from the Samoan Islands, deposited; two Geoffroy's Doves (*Peristera geoffroyi*) from the Island of Fernando de Noronha, and a Gentoo Penguin (*Pygoscelis taeniatus*) from the Falkland Islands, new to the collection, purchased.

KENT'S CAVERN*

BEFORE entering on this, their tenth Report, the committee desire to express their deep sense of the great loss they have sustained in the decease of Prof. Phillips. No member was more regular in his attendance at the meetings of the Committee or felt a livelier interest in the investigation with which they are charged. On March 18, 1874—little more than a month before his lamented death—though suffering from a severe cold, he visited the cavern, when he carefully inspected those branches of it which had been explored, and expressed his admiration of the clearness and importance of the evidence bearing on the question of human antiquity which had been obtained.

The investigation has been pursued without intermission during the entire period which has elapsed since the meeting at Bradford in 1873; the mode of operation has been that described in previous Reports and followed from the commencement; the work has been performed in the most satisfactory manner by the same workmen; and the superintendents have continued their daily visits and carefully recorded the results from day to day.

The interest felt in the exploration by the inhabitants and visitors of Torquay has suffered no abatement, and the superintendents have conducted a large number of persons through the cavern, including the members of the South-western Branch of the British Medical Association during a meeting of that body held at Torquay, and also the members of the Birmingham Natural History and Microscopical Society whilst on a scientific excursion to South Devon.

During May 1874, an arrangement was made with the superintendents by Prof. A. Newton of Cambridge, for Mr. Slater, one of the naturalists of the Rodrigues Transit Expedition, to spend some time in the cavern, studying the mode of exploration followed there; it being probable that he might have to explore some very interesting caves which exist in the island. Mr. Slater reached Torquay on the 1st of June, when everything was done to facilitate his purpose, and he spent some days watching the men at work.

Live rats continue to present themselves in the cavern from time to time, and prove occasionally to be very troublesome. Thus, in October 1873, one carried off six candles during the afternoon from a spot selected because it was believed to be inaccessible even to rats, and which had been used as the candle store during a period of three years without any previous loss of the kind; and in the same month another ate through one of the workmen's basket between the hours of nine and one, and carried off his dinner. A large number have been captured during the last twelve months.

---

* Tenth Report of the Committee for Exploring Kent's Cavern, Devonshire. (Abstract.)

During summer, bees have frequently been seen and heard in the innermost branches of the cavern, very far beyond any glimmering of day-light.

The branches of the cavern in which the researches have been carried on since the ninth Report was presented in 1873, are those known as the Long Arcade, Underhay's Gallery, the Cave of Inscriptions, and Clinnick's Gallery. The exploration of the former two has been completed, but the work is still in progress in the latter. The deposits have been, in descending order, like those reported last year: first, or uppermost, the Granular Stalagmitic Floor, from 12 to 30 inches in thickness; second, the Cave Earth, which has nowhere been more than two feet deep, but has rarely exceeded one foot, and has occasionally thinned out altogether; third, the Crystalline Stalagmitic Floor, usually exceeding the Granular Floor in thickness, but which had, in certain places, been partially broken up and removed by some natural agency before the deposition of the cave earth; and, fourth, or lowest known, the Breccia, consisting of materials not derivable from the cavern hill, and which appear to have been introduced through openings or mouths of the cavern at present choked up and unknown. The depth of this deposit has not been ascertained, as its bottom has nowhere been reached.

In the Long Arcade the surface of the upper or granular stalagmite was occupied with large natural "basins," some of them 12 inches deep, such as have been described in previous Reports. The following points of interest were noted respecting them during the progress of the work:—

1. The stalagmite forming their walls was harder and tougher than that surrounding them; whilst that composing their bottom was comparatively soft and friable.

2. The walls were traceable through the entire thickness of the Stalagmitic Floor; in other words, during the entire deposition of the floor, basins had existed in it, the bottom rising with the walls, but at a slower rate.

3. The water which filled them in rainy seasons passed down through the bottom in three or four hours at most.

4. Immediately beneath most of the basins there was an almost continuous interspace of about half an inch in height between the bottom of the stalagmite and the top of the cave earth; caused, no doubt, by the finer particles of the deposit being carried by the percolating water through interstices to a lower level.

It happened that the exploration of that part of the Arcade in which the basins were thus numerous was carried on during a wet season, when the water, passing through the Stalagmitic Floor, as just mentioned, caused two or three slips of the deposits beneath. In the largest of these a well-rolled flint nodule was found with some remains of animals. No such specimen had been previously seen within the cavern.

At the junction of the Long Arcade, the Cave of Inscriptions, and Clinnick's Gallery, there is a huge boss of stalagmite, in the form of the frustrum of an oblique cone, 43 feet in basal circumference, 14 feet along the slant side—which forms an angle of 40 degrees with the horizon, and thus gives a vertical height of fully 13 feet for the mass—and contains probably no less than 630 cubic feet of stalagmite. Its base consists of the older or crystalline stalagmite, and the upper portion, without any intervening cave earth, of the granular variety, which not only surrounded and completely encased the former, but, by flowing in copious sheets, formed the thick Granular Floor, spreading without a break and for great distances in every direction. Though inscriptions exist in various parts of the cavern, this mass is, with perhaps the exception of the almost inaccessible Crypt of Dates, more thickly scored with names, initials, and dates than any other equal area within the cavern; and hence it has acquired the name of the Inscribed Boss of Stalagmite. The inscriptions occupy its outer or most exposed semi-surface, where in certain places they form a network. Letters of all sizes, from some fully three inches in height to others as small as ordinary writing, cross each other and thus add to the difficulty of decipherment. Some of them were cut with great care and finish, and must have occupied a large amount of time, whilst others were but hasty scratches. It seems to have been somewhat fashionable to surround the inscriptions with rectangular parallelograms, varying from 6·5 to 3·75 inches in length, by 5·5 to 3·5 in breadth. In at least one or two cases the cutting of the parallelogram preceded that of the inscription, as the latter extends beyond the boundary. Not unfrequently several names occur together, whether within a parallelogram or not, and in each such case the entire work seems to have been performed by the same hand. At least four of them belong to the seventeenth century, and the earliest of the series, so far as at present known, is that of "Peter Lemaire, Rich. Colby, of London, 1615." Amongst the names is that of "Deluc," probably the well-known geologist, "Champernowne," that of a well-known old Devonshire family, and several prevalent in the immediate district.

In 1846 the Torquay Natural History Society appointed a committee of three of its members, including the two superintendents of the present exploration, to make some very limited researches in the cavern. One of the spots which that committee selected was in Clinnick's Gallery, immediately adjacent to the inscribed boss, where they made a very small excavation. The materials dug up on that occasion were, as usual at that time, thrown on one side, where they remained until removed in May last when they were taken out of the cavern by the present committee. Before this was done, the surface of the mass was carefully examined to ascertain what thickness had been reached by the stalagmite which, as the superintendents well knew, had been accreting on it during the last twenty-eight years. The result was a small film not thicker than ordinary writing-paper, and limited to two examples, each covering not more than two or three square inches.

Underhay's Gallery was found, when the work of exploration was completed, to be about 10 feet long, from 2·5 to 7 feet wide, and from 6 to 7·5 feet in height, the latter measurement being taken from the bottom of the excavation. Before the committee commenced their operations there, its mouth was almost entirely closed with large masses of limestone. Notwithstanding this, the late Mr. Underhay, for several years guide to the cavern, forced himself into the gallery about fourteen years ago, even though after passing the entrance, he must have found the Granular Stalagmitic Floor within a foot of the roof in certain places. Here he found *on* and *sticking into* the stalagmite a few small bones which he succeeded in bringing out, when they were found to be phalanges of human feet. Though these specimens did not appear to be of an antiquity at all approaching that of the cave-hyæna and his contemporaries, the superintendents, who were familiar with them, very carefully watched the progress of the work, in the hope of finding some further traces of the skeleton; and on reaching Mr. Underhay's very limited diggings they met with a series of bones, all *on* and *in* the stalagmite, some of which were certainly human, whilst others were as clearly not so. The whole were at once sent to Mr. George Busk, a member of the committee, who has been so good as to forward a report on them to the effect that twenty-eight of the specimens are human, and include an astragalus, a navicular bone, a trapezium, a patella, a metatarsal, an ecto-cuneiforme, phalanges of fingers and toes, and fragments of humeri, ribs, and vertebræ; that they appear to be the remains of an adult individual of small size and delicate make, and probably of a female, on which point, however, it is impossible to speak positively; that the bones are not necessarily of any very remote antiquity; that the remaining specimens are not human, but belong to small sheep or goat, probably the former, which must have been of the smallest Welsh type.

When the very contracted character of this gallery, prior to its excavation by the committee, is borne in mind, it is difficult to understand how the remains were introduced. There were neither potsherds nor charcoal, nor, in short, anything suggesting that the bones were the remnants of a body disposed of by cremation, such as were met with in another branch of the cavern in 1872; nor were there any marks of teeth on the bones such as might have been expected had they been taken thither by a carnivorous animal, or the relics of a skeleton buried or secreted there, of which all other portions had been carried off by some carnivore.

The only noteworthy objects met with in the Granular Stalagmitic Floor during the year were a tooth of bear, fragments of bone, one considerable "find" of coprolites, and charred wood on two occasions, all of which occurred in the Long Arcade.

The Cave Earth has yielded during the period under notice 187 teeth of various kinds of mammals, of which 94 occurred in Underhay's Gallery, 63 in the Long Arcade, 20 in the Cave of Inscriptions, and 10 in Clinnick's Gallery; 102 belonged to hyæna, 36 to bear, 27 to horse, 8 to elephant, 8 to fox, 4 to rhinoceros, 1 to lion, and 1 probably to wolf. There were also numerous bones and fragments of bone, of which some were gnawed, and a few appear to have been burnt. Coprolites were very abundant, 69 distinct "finds" having been met with during the twelvemonth. They sometimes, though rarely, consisted of a solitary ball, whilst at others upwards of 20 were lying together and not unfrequently cemented into large lumps. Occasionally the amount of matter of this kind found in a single day was sufficient to fill a large basket.

Fifteen specimens of flint and chert were also met with in the cave earth, 6 of them occurring in the Cave of Inscriptions, 5 in Underhay's Gallery, 2 in the Long Arcade, and 2 in Clinnick's Gallery. The finest of the series is No. 6324, found December 30, 1873, in the second foot-level, beneath the floor of granular stalagmite from 2 to 2·5 feet thick. It is a very symmetrical tongue-shaped tool, fashioned with much labour out of a chert nodule, and worked to an edge all round the perimeter except at the butt end, where portions of the original surface remain on both faces. It is 3·8 inches long, 2·3 inches in greatest breadth, 1·5 in greatest thickness, and convex on both faces, from each of which several flakes have been struck. Though fashioned out of a nodule, which is very rarely the case amongst the cave-earth implements, its symmetrical form and comparatively high finish are highly characteristic of the era to which it belongs.

No object of interest of any kind has been found in the Crystalline Stalagmitic Floor during the year; but the Breccia lying beneath it has been by no means unproductive. In this oldest of the cavern deposits the remains have been, as heretofore, exclusively those of bear, so far at least as is at present known, and in addition to a large number of bones, including a considerable portion of a skull, 441 teeth have been met with in it, of which 149 were in the Long Arcade, 115 in Underhay's Gallery, 91 in the Cave of Inscriptions, and 86 in Clinnick's Gallery.

Twenty-six specimens of flint and chert have also been found in this deposit, of which 10 occurred in the Long Arcade, 6 in Clinnick's Gallery, 5 in Underhay's Gallery, and 5 in the Cave of Inscriptions.

The finest of the series (No. $\frac{7}{11}$) and indeed one of the finest the cavern has yielded from the commencement, was found April 23, 1874, in the fourth or lowest foot-level, with 1 tooth of bear, fragments of bone, and a small chert flake (No. [illegible]) which had probably been rolled. It measures 4·5 inches in length, 3 inches in greatest breadth, 1·1 inch in greatest thickness, is very convex on one face, slightly so on the other, retains a portion of the original surface near the butt end, and is rudely quadrilateral in form, with the angles rounded off. Several flakes have been struck off each face, and the edge to which it has been reduced along its entire margin, except at the butt end, is by no means sharp; its surface is almost completely covered with an almost black, probably manganesic smut, whilst a slight chip near the pointed end shows it to consist of a very light-coloured granular chert. Several lines betokening planes, probably of structural weakness or perhaps of fracture, entirely surround it. If it has really been fractured, it must have occurred where the tool was found, and the parts have been naturally reunited without being faulted. Its character as well as its position shows that this fine implement belonged to the era of the Breccia.

This specimen is of considerable interest, both on account of the lines which cross its surface and of the position it occupied.

Amongst the flint implements found in Brixham Cavern that known as No. 6—8 has attracted considerable attention, and has been described and figured by Mr. John Evans, both in his "Ancient Stone Implements" and in the "Report on the Exploration of Brixham Cave." It was found in two pieces, the first on the 12th of August, 1858, the second, 40 feet from it, on the 9th of the following September; and it was not until some time after the latter date that the late Dr. Falconer discovered that the two fragments fitted each other, and when united formed a massive spear-shaped implement. The lines on the Kent's Cavern specimen just described show that it had either been fractured where it was found, or, what seems more probable, that it is traversed by planes of structural weakness, such that a slight blow would break it into two or more pieces, which a stream of water would easily remove and probably separate, and thus produce a repetition of the Brixham case.

The Kent's Cavern tool was found in a small recess in the wall, just within the outer or wider entrance of Clinnick's Gallery, within a very few feet of the Inscribed Boss of Stalagmite, and, as has already been stated, in the fourth foot-level of the Breccia; that is, at the greatest depth in the oldest of the cavern deposits to which the present exploration has been carried, and is thus wonderfully calculated to take the mind step by step back into antiquity.

First, very near the spot occupied by the specimen, there rises a vast cone of stalagmite, which an inscription on its surface shows has undergone no appreciable augmentation of volume during the last two-and-a-half centuries.

Second, prior to that was the period spent in raising the greater portion of this cone, which measures upwards of 40 feet in basal girth, reaches a height of fully 13 feet, and contains more than 600 cubic feet of stalagmitic matter.

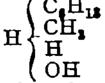
Third, still earlier was the era during which the cave earth was introduced, in a series of successive small instalments with protracted periods of intermittence, when the cavern was alternately the home of man and of the cave hyæna, and the latter dragged thither piecemeal so many portions of extinct mammals as to convert the cave into a crowded palæontological museum.

Fourth, further back still, was the period during which the base or nucleus of the cone or boss was laid down in the form of crystalline stalagmite.

Fifth, and earliest of all, was the time when materials not derivable from the immediate district were carried into the cavern, through openings now probably choked up, entirely unknown, and the direction in which they lie but roughly guessed at, when apparently the cavern-haunting hyæna had not yet arrived in Britain. At an early stage in this earliest era man occupied Devonshire; for prior to the introduction of the uppermost four feet of breccia, one of his massive unpolished tools, rudely chipped out of a nodule of chert, found its way into a recess in the cavern, and having a character such as to show that it must have lain undisturbed in the same spot until it was detected by a committee of the British Association.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for September contains the following papers communicated to the Society:—On the products of the decomposition of castor oil, No. 3. On the decomposition by excess of alkaline hydrate, by E. Nelson. The action of sodium hydrate mixed with water gives rise to the formation of a mixture of an alcohol and a ketone on distillation. The alcohol is an octylic alcohol, which the author regards as the secondary alcohol methyl-hexyl carbinol



$H\left\{\begin{array}{l}C_6H_{13}\\CH_3\\H\\OH\end{array}\right.$

The ketone is methyl-hexyl ketone. The olefine derived from the alcohol has been examined. The supposed heptylic alcohols of Städeler and Petersen turn out to be a mixture of octylic-alcohol with methyl-hexyl ketone.—On the action of nitrosyl-chloride on organic bodies, Part I. On phenol, by Dr. W. A. Tilden. The phenol is oxidised to quinone, which substance is then converted into chloranil, the nitrosyl-chloride being completely reduced—a certain amount to ammonium chloride.—Aniline and its homologues, &c., in coal-tar oils, by Watson Smith.—On the action of chlorine, bromine, &c., upon isodinaphthyl, by Watson Smith and James M. Poynting. The action of chlorine gives rise to the formation of a tetrachlorinated derivative, $C_{20}H_{10}Cl_4$. Bromine replaces seven atoms of hydrogen, giving rise to the compound $C_{20}H_7Br_7$. With concentrated sulphuric acid a conjugate acid is formed, of which the barium and sodium salts have been examined. Both the chlorinated and brominated derivatives are amorphous powders.—On hydrogen persulphide, by William Ramsay. The persulphide was prepared by first saturating alcohol with ammonia gas, and then passing sulphuretted hydrogen through the solution. The ammonium sulphide thus produced was shaken up with sulphur and a solution of strychnine in alcohol added. White crystals having the formula $C_{21}H_{22}N_2O_2H_2S_3$ separate out on standing. These crystals treated with sulphuric acid yield hydrogen persulphide in the form of oily globules, but the yield is small, and the separation from the sulphuric acid extremely difficult. The author finally adopts the old method of pouring calcium persulphide into hydrochloric acid. Analyses of the compound thus obtained gave results indicating a formula between H_2S_7 and H_2S_{10}. The properties of the persulphide have been examined in some detail.—The journal contains its usual valuable collection of abstracts.

Geological Magazine, Oct. 1874.—The original articles contained in this number are (1) a continuation of Mr. Lechmere Gupp's article on West Indian Tertiary Fossils; (2) Notes on the impression of *Palæontina oolitica* in the Jermyn Street Museum, by A. G. Butler, including a discussion on its zoological place; (3) The structure of Lambay Porphyry, by Prof. Hull, a paper read before the Geological Society of Ireland; (4) Geology of West Galway and South-west Mayo, by S. H. Kinahan, an epitome of a communication made to the British Association; (5) Note on the Phonolite of the Wolf-rock, by S. Allport.

Zeitschrift der Œsterreichischen Gesellschaft für Meteorologie, Sept. 15.—This number contains a description of the self-acting printing barometer, invented some years ago by Mr. Hough, director of the Observatory at Albany, U.S., but not very well known in Europe. By the employment of electricity, the barometer will record movements as slight as ·0005 in., and will print not only curves, but a register as well, at any required intervals per hour. The apparatus does not require frequent attention.—Among the *Kleinere Mittheilungen*, we have a notice of M. Goulier's aneroid, provided with a scale of heights beside the scale of millimetres. It is contended against this arrangement that two scales make a correct reading less easy; that the precision of the scale of heights, where the intervals between the lines are not equal, must be doubtful, and that the correction proper to each aneroid would not be easily applied to the scale of heights.—M. Mühry has an article On differences of temperature as a cause of latitudinal oceanic circulation. He maintains that two causes are at work, each of which tends to produce latitudinal circulation, namely, the diminution of the force of gravity towards the equator, and the increase of temperature with consequent expansion and diminished specific gravity. The lower strata of cold water rise at the equator towards the surface, and a corresponding descent of warm upper strata must take place in polar regions. With regard to the debated question on the point of greatest density of sea-water, he holds it to be the same as that of fresh water, and late experiments bear out his argument on this subject.

Bulletins de la Société d'Anthropologie de Paris, fascicule vi. tome 8, 1874.—In the closing number of the Society's last year's Reports, the remains found at Solutré, near Macon (in August 1873), formed a large proportion of the subjects of the papers. The assumed find at Solutré of a metallic ring, enamelled green, on one of the phalanges of the skeleton which had been uncovered in the presence of MM. de Quatrefages, Broca, and nearly fifty other persons, has been rejected by the Society as unworthy the consideration of scientific men; while M. Broca, in a detailed report of the investigation in which he on that occasion took the principal share, has clearly shown the impossibility of such a ring escaping his notice had it been present. M. Broca in another paper considers at length the characteristics of the various crania which have been found at Solutré since the spot was first examined by MM. de Ferry, Arelin, de Fremlnville, Lortet, and others, and described by the two first-named in their work "Le Mâconnais Préhistorique" (1870): and he draws attention to the various prehistoric and historic epochs at which interments have been made at Solutré, and by which the question of the true age of these remains has been surrounded with greater difficulties than belong to the palæontological character of any other similar spot in France. The prehistoric crania at Solutré are in a very bad condition; but they present a large capacity of nearly 1,600 cubic centimetres, with an index of only 82·87. Platycnemic tibiæ, with the characteristic columnar femures, were found, but M. Broca seems on the whole to assume that the earliest discovered men of Solutré belonged to a mixed race similar to those of the Belgian caves of La Lesse. M. Hamy has demonstrated that brachicephalic crania supervene at Solutré on the dolichocephalic, as at Cro-Magnon.—M. Topinard read a paper on the systems of craniometry, in which he endeavoured to show by the contradictory cranial determinations arrived at in reference to the Solutré and other recent finds, how important it is to show a definite method of cranial measurement. In the discussion which followed, M. Rochet opposed the notion that craniometry in art is based upon individual fancy more than scientific accuracy; while M. Broca admitted the defects of the present methods.—A note by M. P. Bert, on the twin monster known as the double-headed nightingale, led to a general discussion on double or twin monsters, and to the inquiry whether they were produced from two distinct embryos or from one germ endowed *ab initio* with the property of doubling or reproducing certain parts. It was generally admitted that external circumstances have no power to induce embryonic duality.—Madame C. Royer, in a very original paper on the origin of different human races, protested against the hypothesis which derives all European races from Asia, and endeavoured to show by the geological history of the earth that man must have appeared first on the great Austral continent, and radiated thence to the other continents. Her novel views were received with marked attention, and it was felt that if she should be able to adduce sound geological proof of her statements, her hypothesis of primary human migrations will be as important as it is original. Till she fulfils her promise of clearly expounding her theory, her arguments cannot, however, be accepted as more than ingenious speculations.

Revue d'Anthropologie, tome iii. No. 3.—M. Paul Broca supplies us in this number of the review, of which he is sole editor, with a comprehensive history of the course of observations which have led to the enunciation of the theory propounded by him (in the *Bulletins de la Soc. d'Anthrop. de Paris* for January and February 1874) in regard to the hygrometric properties of fossil crania. After considering the important but inadequately appreciated experiments made in 1859 by M. Welcker in reference to this point, he enters at great length into the consideration of the numerous carefully conducted series of observations and measurements by which he was led to the conclusions which he has adopted, and his paper constitutes, therefore, a most valuable *résumé* of the physical as well as the palæontological bearings of the subject.—M. Bérenger-Feraud, surgeon in the French navy, gives, as the result of personal investigation, an account of the different tribes who occupy the shores of the Casamanca in Intertropical Africa. This stream, on which the Portuguese and French have a few scattered trading stations, is one of the numerous rivers of Western Africa which take their source on the western slope of the Fouta-Djalon mountain-ranges. The author considers the Casamanca peoples under the three heads of primary or autochthonic, invading, and immigrating races; the first including the Feloups and Bagnouns, the second the Belantes, Mandingues, and Peuls, and the last the Onolofs, Saracolais, Machouins, Taumas, &c.; and passing each in review, he describes their habits, the form of fetichism followed by each, and their general social condition. Among the Balantes he notes the singular custom of making the duration of marriage responsibilities dependent on the conservation of the "pagua" or festive garment given to the wife by the husband on the occasion of their wedding. The woman who wishes to secure a divorce has merely to wear out her pagúa as fast as she can, and then present it in a tattered condition to her family, on which she obtains her release from the power of her husband. Among the same people a charge of sorcery, which is very common with them, can only be met by a public appeal to the ordeal of the "mançone" or "ago broumedion," which is said to be a decoction from the bark of a poisonous tree, and which it would appear is always fatal unless rich gifts have secured the copious watering of the draught by those to whom its preparation is confided.—MM. Daleau and Gassies give a report of the appearances presented by a cavern at Jollas, in the canton of Bourg (Gironde), which, on its recent exploration, yielded in a stratum of red diluvium below a solid calcareous bed, a rich deposit of bones, many of which had been cleft, but none of which belonged to extinct species, numerous flint implements similar to those found at Moustier and Solutré, but no remains of pottery, except in the upper part of the cavern, where they had probably been thrown aside long after the disuse of the cavern.

Zeitschrift für Ethnologie, heft vi. 1873.—The first article in this number gives some interesting details in regard to the almost unknown Red Indian tribe of the Tulus of Panama, believed to be the descendants of the Churchures, who successfully resisted the attempts made by the Spanish Conquistadores for their subjection. Representatives of these people appeared last year at Bogota with the object of making complaints against the collectors of caoutchouc, cacao, and elephant nuts, who had come to their woods and been guilty of violence against the tribe, and it was from his examination of these men that the author drew up his report.—In a suggestive article by Prof. Bastian on the nature of ethnology and its relations to geography, the author points out how essential the knowledge of physical laws is to the right comprehension of ethnology, which is in itself less a zoological history of man than a history of the geographical distribution of man considered in relation to physical habits, which, like the physical characteristics of different faunas and floras, depend primarily upon geographical position, and secondarily on climatic, geognostic, and other analogous conditions.—Herr Virchow laid before the society several skulls of the Goldi, a hitherto almost unknown tribe, who occupy the shores of the Amoor at the point where the Sangari and the Ussuri join the main stream. He is of opinion that these people are more nearly allied to the Tunguses than to the Esquimaux, the crania in his possession being remarkable for their high brachicephalic form and large cranial capacity.—In a letter from Dr. Bleek, addressed to the society, the writer draws attention to the peculiarity evinced by the Bushmen of becoming fairer and lighter in skin after they have for a time enjoyed good and abundant food, with the comforts of civilised life. This special characteristic he regards as a proof of the difference between these peoples and the negro races of South Africa, and as an evidence of their nearer affinity with more northern tribes. Dr. Bleek at the same time expresses his opinion that the dances by moonlight, which are systematically practised by the South African tribes, are connected with some form of moon-worship; while Dr. Fritsch, on the other hand, believes that these dances are in no way religious, and are simply called forth by the charm of tropical moonlit nights.—Herr Virchow exhibited some stone implements or wedges precisely similar to the so-called flint knives, which we are accustomed to assign to the Stone Age; yet these were of modern fabrication, being made in the present day in Syria, where they are used, amongst other purposes, to keep the different parts of the Syrian threshing machine (*tribulum*) in their places.

Astronomische Nachrichten, No. 2,007, contains the observations of position and magnitude of 148 comparison stars and 13 minor planets, made with the meridian circle at Berlin.—No. 2,008 contains the positions of 108 more stars, reduced to the mean equinox of 1870, and the positions of 20 planets, made by the same instrument. With the Berlin refractor the positions of some 58 planets have been determined, and some of them have been observed on a number of nights.—In No. 2,009 L. Schulhof gives an ephemeris and the following elements of Comet III. 1874, discovered by Coggia on the 19th of August:—

$$T = \text{July } 5{\cdot}16629 \text{ Berlin time.}$$
$$\pi = 347^\circ\ 20'\ 2''$$
$$\Omega = 213^\circ\ 12'\ 15''$$
$$i = 28^\circ\ 25'\ 41''$$
$$\log. q = 0{\cdot}15831$$

M. Geelmuyden gives elements of Coggia's first comet of 1874, and assigns a period of 10,445 years.—D'Arrest contributes a number of spectroscopic observations of Secchi's types III. and IV.—Ormond Stone gives a note on certain expressions of the distance of a comet from the earth, and a paper on Brunnow's method of correcting the orbit of a comet.—Dr. Holetschek gives an ephemeris of Borrelly's comet, the two last positions of which are—

		R.A.	DEC.
Oct. 29	...	6h. 21m. 9s.	+ 50° 37′·6
Nov. 2	...	6h. 5m. 11s.	+ 47° 36′·7

and an ephemeris of Coggia's comet of the 19th of August—

Oct. 29	...	5h. 0m. 41·8s.	− 0° 12′ 55″
Nov. 2	...	4h. 48m. 46·4s.	− 1° 49′ 50″

Memorie della Società degli Spettroscopisti Italiani, August.—Father Secchi contributes a paper discussing the theory of solar spots set forth by Galileo, and he compares the theories and observations of Wilson, Kirchhoff, Faye, and Gautier. Tacchini adds a note discussing M. Faye's theory of the formation of solar spots, and opposing it on the ground that spots and faculæ seem to accompany eruptions. Tacchini also gives notes on the positions of the chromosphere where magnesium vapour was observed in January last, and he also mentions the position of prominences accompanying spots at the limb, and containing metallic vapours. The magnesium line and 1474 occur most frequently.—Notes and measurements of the comet (Coggia) made by E. Dembowski with a 7-inch Merz, together with drawings of the nucleus, appear in this number.—Schiaparelli contributes a note on the new star observed in Sagittarius in 1690. He thinks it the same as the variable star S Sagittarius, R.A. 287° 40′, Dec. 19° 18′.—Tacchini gives a table with notes showing the number of meteors, with their brightness, observed in each fifteen minutes from 10h. 30m. to 13h. 15m. on the 9th, 10th, and 11th of August last. The radiant point

				R.A.		DEC.
On the	9th,	of 35,	was	2h. 52m.	...	54° 56′
„	„	of 3,	„	2h. 14m.	...	55° 43′
„	10th,	of 71,	„	2h. 53m.	...	54° 40′
„	„	of 11,	„	2h. 14m.	..	56° 14′
„	11th,	of 14,	„	2h. 53m.	...	54° 43′
„	„	of 10,	„	2h. 14m.	...	56° 20′

SOCIETIES AND ACADEMIES

MANCHESTER

Literary and Philosophical Society, Oct. 6.—Rev. William Gaskell, M.A., vice-president, in the chair.—On the ossiferous deposit at Windy Knoll, near Castleton, by Mr. Rooke Pennington, LL.B.—On some teeth from a fissure in Waterhouses Quarry, in Staffordshire. Mr. Pennington called attention to some teeth of a bison (*Bos priscus*) from a fissure in a quarry at Waterhouses. The animal had evidently fallen in while coming to drink at the river Hamps. It had been erroneously described as an Irish elk.—On the extent and action of the heating surface for steam boilers, by Prof. Osborne Reynolds, M.A.—Dr. Joule made a further communication respecting his mercurial air pump described in the Proceedings for Dec. 24, 1872, and Feb. 4, Feb. 18, and Dec. 30, 1873. He had successfully made use of the glass plug proposed in the Proceedings for Feb. 4, 1873. This he constructs by blowing out the entrance tube and grinding the bulb thus formed into the neck of the thistle-shaped glass vessel. To collect the pumped gases he now employs an inverted glass vessel attached to the entrance tube and dipping into the mercury in the upper part of the thistle glass.

WINCHESTER

The Winchester and Hampshire Scientific and Literary Society held the first meeting of its sixth session on Oct. 19; Dr. Heale, treasurer, in the chair.—The Rev. F. Howlett, F.R.A.S., delivered an introductory address, noticing many of the more important discoveries made during the past year in various departments of scientific research.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Report of the Weather Telegraphy (E. Stanford).—Annual Report Aeronautical Society of Great Britain (Hamilton and Co.).—Journal of the Iron and Steel Institute, 1874 (Spon).—Note on the Perception of Musical Sounds: J. G. McKendrick, M.D. (Neill and Co.).—Flora Cravoniensis: John Windsor, F.R.C.S., F.L.S., &c. (Cave and Co.).—The Contrast between Crystallisation and Life: John E. Howard, F.R.S., F.L.S., &c. (Hardwicke).—Atomism: Dr. Tyndall's Theory Examined and Refuted: Rev. Prof. Watts, D.D. (Mullan, Belfast).—Brixham Cavern: N. Whitely, C.E. (Hardwicke).—Philosophy, Science, and Revelation: Rev. C. B. Gibson, M.R.I.A., &c. (Longmans).

AMERICAN.—Nomenclature of Diseases: J. M. Woodworth, M.D. (Washington).—Proceedings of the American Association for the Advancement of Science.—Notes on Ophidiidæ, &c.: F. W. Putnam.

FOREIGN.—L'Astronomie Pratique: C. André and G. Rayet (Gauthier-Villars, Paris).—Einige Bemerkungen uber den Werth, welcher im Allgemeinen den Angaben in Betreff der Herkunft menschlicher Schadel aus dem ostindischen Archipel beizumessen ist: Dr. Meyer (Wien).—Uber neue und ungenügend Vögel von New Guinea und den Inseln der Gelvincks Bai: Dr. Meyer.—Manuel de la Cosmographie du Moyen Age: A. F. Mehren (Copenhagen).—Neues Handworterbuch der Chemie: Dr. H. von Fehling (Viewig and Son).—Die Geologie: Franz Ritter von Hauer (A. Holder, Wien).—Normale Zeiten für den Zug der Vogel: K. Fritsch (Wien).—Fossilen Bryozoen: Prof. Dr. A. E. Roon Reuss (Wien).—I precursori di Copernico nell' antichità: G. V. Schiaparelli (W. Hoepli).—Osservazioni Astronomiche e Fisiche: G. V. Schiaparelli (W. Hoepli).

CONTENTS

PAGE
METEOROLOGY IN FRANCE 515
MAREY'S "ANIMAL MECHANISM," II. (*With Illustrations*) 516
OUR BOOK SHELF 519
LETTERS TO THE EDITOR:—
  Automatism of Animals and Men.—DOUGLAS A. SPALDING 520
  The Edible Frog.—Lord ARTHUR RUSSELL 520
  Colour in Flowers not due to Insects.—G. S. BOULGER; THOMAS COMBER 520
  Migration of Birds.—GEORGE J. ROMANES 520
  The Aboriginal "Murri" Race of Australia.—Rev. WILLIAM RIDLEY 521
  Reported Discovery of Gold in Samoa.—Rev. S. J. WHITMEE 522
  Photographic Irradiation.—A. COWPER RANYARD, F.R.A.S. 522
  Curious Rainbow.—G. J. THOMSON 523
  Aurora.—JAMES S. ANDERSON 523
  Sneezing in Animals 523
THE RECENT ERUPTION OF ETNA 523
THE SECOND AUSTRO-HUNGARIAN EXPEDITION TO THE NORTH POLE, UNDER THE DIRECTION OF WEYPRECHT AND PAYER, 1872–74 (*With Illustrations*) 523
PHYSICS AT THE UNIVERSITY OF LONDON, II. By Prof. G. CAREY FOSTER, F.R.S. 525
NOTES 527
KENT'S CAVERN 530
SCIENTIFIC SERIALS 532
SOCIETIES AND ACADEMIES 534
BOOKS AND PAMPHLETS RECEIVED 534

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 236, VOL. 10] THURSDAY, MAY 7, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved

BRITISH ASSOCIATION for the ADVANCEMENT OF SCIENCE,

22, Albemarle Street, London, W.

The NEXT ANNUAL GENERAL MEETING will be held at BELFAST, commencing on WEDNESDAY, August 19.

President-Elect,

Professor TYNDALL, D.C.L. LL.D. F.R.S. F.C.S.

NOTICE TO CONTRIBUTORS OF MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ." If it should be inconvenient to the Author that his paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,
Assistant General Secretary, Harrow.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

RICHARD A. PROCTOR, Esq., Author of "Saturn," "The Sun," &c., will, on SATURDAY next, May 9, at Three o'clock, begin a Course of Five Lectures "On the Planetary System."

NEVIL STORY MASKELYNE, Esq., M.A. F.R.S. Keeper of the Mineral Department, British Museum, will, on THURSDAY next, May 14, at Three o'clock, begin a Course of Four Lectures "On Physical Symmetry in Crystals."

Subscription to each Course, Half-a-Guinea; to all the Courses in the Season, Two Guineas.

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS

(stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X Y Z., care of the Publisher of NATURE, 24, Bedford Street, Strand, W.C.

CHARING CROSS HOSPITAL MEDICAL SCHOOL.

SUMMER SESSION, 1874.

A Course of Lectures on Zoology and Comparative Anatomy will be delivered by A. H. GARROD, Esq., Fellow of St. John's College, Cambridge, preparatory for the Examinations of the University of London, Fellowships of the College of Surgeons, and Civil Service. Fee for the Course, £3 3s.

FRANCIS HIRD, Dean

KING'S COLLEGE.

GEOLOGY.—EVENING CLASSES

A Course of Lectures on "The Lower Forms of Past Life as illustrated by Fossils," will be given by the Rev. THOS WILTSHIRE, M.A. F.G.S. on Monday Evenings, commencing April 27th. There will be also one or more Field Lectures in the neighbourhood of London during the present Term, and an Excursion of two or three days' duration at a distance from London. For additional information apply to the Secretary, King's College, Strand, London.

PRELIMINARY EXAM. IN ARTS, COLL. SURG., June 1874.

MR. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, will shortly begin to read with Classes for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has passed several Pupils for this Examination, to whom references are allowed. An early Class will commence towards the latter part of February and a later one about Lady Day. Fee for the Course, from 7 to 12 guineas, according to the time of commencement and number of subjects taken up.—Address, 24 Old Square, Lincoln's Inn, W.C.

MATRICULATION EXAMINATION, LOND. UNIV., June 1874

MR. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, reads with Pupils for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Examination, having passed fifty-three Pupils, to whom references can be given. An early class about Lady-day, and a later one will commence the middle of February. Fees for the two, 14*l.* and 10*l.* 10*s.* respectively. For further particulars, address to 24, Old Square, Lincoln's inn, W.C. Two of Mr. Hanbury's pupils passed the Matriculation Examination in January 1873, in the Honours-list, seventh and fourteenth respectively.

A few Residents can be accommodated in Mr. Hanbury's house, at Clapham

ODONTOPTERYX TOLIAPICUS (Owen).

—Casts of the Head of this new rare Bird from the London clay of Sheppey, described by Prof. Owen, and formerly in the possession of Mr. Bryce M. Wright, can now be procured. Price 2*s.* 6*d.* each; coloured, 4*s.* BRYCE M. WRIGHT, Dealer in Minerals, Fossils, Shells, Ethnological and Ethnographical Implements, 90, Great Russell Street, Bloomsbury, London.

SCIENTIFIC BOOKS.—A few copies can

still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Conchologorum, Tankerville Cat., &c., &c., as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c. &c. SOWERBY, 167A, Strand.

LONDON INTERNATIONAL EXHIBITION, 1874.—OPEN DAILY, 10 a.m. to 6 p.m.

THE FRENCH PICTURE GALLERIES are NOW OPEN.

THE EXHIBITION OF WINE IS OPEN DAILY from Twelve to Five. Visitors to the Exhibition will be charged 6d extra for admission to the Cellars of the Royal Albert Hall. Entrance Kensington Road. Exhibitors of Wine are allowed to have their wine tasted by visitors.

LONDON INTERNATIONAL EXHIBITION.

SEASON TICKETS.

A. Non transferable Ticket … … … … … … … … £2
B. Non-transferable Ticket, with 120 artisans', or 240 school tickets … … … … … … … … … £3
C. Transferable Ticket, with 100 artisans' or 400 school tickets £5

Season Ticket holders of £3 and £5 tickets are registered as MEMBERS FOR PROMOTING TECHNICAL INSTRUCTION.

CHARGES FOR ADMISSION.—1s daily, except on Wednesdays, 2s. 6d.

LONDON INTERNATIONAL EXHIBITION.—A MILITARY BAND PLAYS in the French Garden on THURSDAYS, from Three to Five, and in the Western Annexe on SATURDAYS, from Three to Five

ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN AND IRELAND,

4, St. Martin's Place, Trafalgar Square, W.C.

(In which are united the Anthropological Society of London and the Ethnological Society of London.)

President … … … Prof. Busk, F.R.S.
Treasurer … … … Rev. Dunbar I. Heath, M.A.
Director … … … E. W. Brabrook, Esq. F.S.A.

The Institute will meet on Tuesday, May 12th, at 8 o'clock p.m. precisely, when the following Papers will be read:—

1.—"On Statistics obtained from Schools." By Francis Galton, Esq., F.R.S.
2.—"On the Excess of Female Population in the West Indies." By Francis Galton, Esq. F.R.S.
3.—"On the Extinction of Families." By the Rev. H. W. Watson, M.A.
4.—"On Ancient Stone Monuments of the Nágás." By Major H. Godwin Austen, F.R.G.S.

An Exhibition, of Gold Objects recently brought from Ashanti, by Messrs. R. and S. Garrard and Co., will precede the reading of the papers.

J. FRED COLLINGWOOD, *Secretary*.

NATURAL SCIENCE.—An Associate of Royal School of Mines, Whitworth Scholar, and Forbes' Medallist, is open to an Appointment in Chemistry, Physics, or Biology.—Address, A.R.S.M., Publisher of NATURE, 29, Bedford Street, Strand, W.C.

REQUIRED, a MATHEMATICAL and NATURAL SCIENCE MASTERSHIP in a good School, by a CAMBRIDGE HONOUR-MAN.—Address—Alpha, care of the Publishers of NATURE, 29, Bedford Street, Strand, W.C.

WANTED.—An Assistant with a knowledge of Astronomy, Chemistry, and Photography for Observatory Work connected with Spectroscope.—For terms, &c., apply by letter to R.S.N., care of the Publishers of NATURE, 29, Bedford Street, Strand

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS. Must all be well authenticated.—Apply, stating terms, to E. E. B., care of Messrs. MACMILLAN and Co., Bedford Street, Strand, W.C.

ICE SAFES & WENHAM LAKE ICE.

THE
WENHAM LAKE ICE COMPANY'S CELEBRATED ICE
(In Town or Country),
American Ice, Water Pitchers, Ice Butter Dishes, Ice Cream Machines.
PRIZE MEDAL & NEW DUPLEX REFRIGERATORS,
Fitted with Water Tanks and Filters, and all Modern Improvements,
CAN BE OBTAINED ONLY AT THE SOLE OFFICE,
THE WENHAM LAKE ICE COMPANY,
125, STRAND, LONDON, W.C. (CORNER OF SAVOY STREET)
Illustrated Price Lists free.

W. LADD & CO.'S

DIFFRACTION SPECTROSCOPE

In leather case for the pocket. Price 15s.

MANUFACTURERS OF SCIENTIFIC & EXPERIMENTAL APPARATUS BY APPOINTMENT TO THE ROYAL INSTITUTION OF GREAT BRITAIN.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly,

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
,, Double ,, 31s 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s and 52s. 6d.
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,
Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

Now ready,

NEGRETTI & ZAMBRA'S

NEW ENCYCLOPÆDIC CATALOGUE

Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard

METEOROLOGICAL INSTRUMENTS,

Containing very numerous Comparative Tables of Reference, and Illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s 6d.

NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,
HOLBORN VIADUCT,
45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens … … … One Guinea.
British Fossils—100 ,, … … … One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R ELLIS & SON, RUTHIN," and every Label bears their Trade Mark Sold everywhere, and Wholesale of R. Ellis & Son, Ruthin, North Wales.

LONDON AGENTS;—W. Best & Sons, Henrietta Street, Cavendish Square.

SALMON, ODY, & CO.,

MANUFACTURERS OF

TRUSSES AND ELASTIC STOCKINGS,

OF THE

BEST MATERIALS & WORKMANSHIP ONLY.

AT MODERATE PRICES.

To his late Majesty William the Fourth, and to Her Majesty's Army and Navy.

292, STRAND, LONDON. ESTABLISHED A.D. 1806.

N.B.—Ladies' Abdominal Belts.

JAMES WOOLLEY, SONS, & CO.

69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,

For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS

For the various Public Examinations.

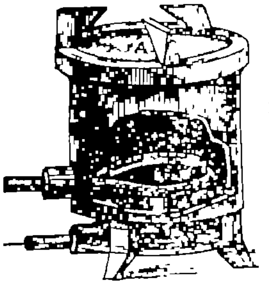
Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

1871.—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873.—INTERNATIONAL EXHIBITION PRIZE MEDAL.

FLETCHER'S

NEW LOW TEMPERATURE BURNER (PATENT)



This Burner gives a range of heating power from a gentle current of WARM air to a BRIGHT RED HEAT, and is so perfectly under control that a common glass bottle may be placed on the tripod without protection and heated to any required temperature without the slightest risk of fracture. In practical use it dispenses with the necessity for drying-closets, sand-and-water baths, &c

For very low temperatures the ring must be lighted through the opening B; this causes a current of warm air to rise through the gauze above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube.

Price, without blast tube ... ... 7s. 6d.
,, with blast tube for high temperatures ... 9s. 0d.

UNIVERSAL FURNACE (GAS),

For High Temperatures (without blast) for Crucibles, Muffles, &c., in several sizes and patterns Special designs made to order.

NEW BUNSEN BURNERS, giving a range of temperature up to a clear white heat, 10s. 6d

HOT BLAST BLOWPIPES, giving temperatures exceeding the fusing-point of platinum, 11s 6d, 13s., 15s.

POWERFUL FOOT-BLOWERS, 18s

Drawings and description from dealers in Chemical Apparatus, or from

THOMAS FLETCHER, F.C.S.,
13 & 15, SUEZ STREET,
WARRINGTON.

Second Edition, royal 8vo, cloth extra gilt, 31s. 6d.

THE DEPTHS OF THE SEA:

An Account of the General Results of the Dredging Cruises of H.M.SS. *Porcupine* and *Lightning* during the Summers of 1868–69–70, under the scientific direction of

Dr. CARPENTER, F.R.S. J. GWYN JEFFRIES, F.R.S., and Dr. WYVILLE THOMSON, F.R.S.

By C. WYVILLE THOMSON F.R.S.

Director of the Civilian Scientific Staff of the *Challenger* Expedition.

Illustrated by 8 Maps and Plates and nearly 100 Woodcuts.

"The book is full of interesting matter, and is written by a master of the art of popular exposition. It is excellently illustrated, both coloured maps and woodcuts possessing high merit. Those who have already become interested in the dredging operations will, of course, make a point of reading this work; those who wish to be pleasantly introduced to the subject, and rightly to appreciate the news which arrives from time to time from the *Challenger*, should not fail to seek instruction from Prof. Thomson."—*Athenæum.*

"Marked throughout by logical command of facts, no less than by patience and skill in accumulating them, the mastery which Prof. Wyville Thomson shows over the results arrived at during this comparatively restricted series of explorations augurs well for the harvest of knowledge to be reaped, we may hope, in the course of the more adequately equipped and more extensive survey over which he has now gone forth in supreme control."—*Saturday Review.*

"Even to the non-scientific who understands neither Latin names nor Miller-Casella thermometers, this book may still be full of interest, if he who glances at it cares to see what a wonderful world he lives in, and how very little he knows of it. The book is worth having, if only for the illustrations. Looking at the engravings, it is not too much to say that no such illustrations of the peculiarly delicate and complicated forms of animal life have yet appeared."—*Times.*

"As a profoundly valuable contribution to science, as a literary effort of high order, or as an elegantly artistic volume, this book is worthy of the warmest praise. The simplicity of style and clearness of description are very high merits."—*Quarterly Journal of Science.*

"For all time will be a standard work in connection with this particular subject."—*Morning Post.*

"The illustrations are admirable; we have rarely seen figures on wood so exquisitely drawn and engraved or so carefully printed. Take it all in all, it is a work of rare merit, and will be of enduring utility; it does infinite credit to all concerned in its production."—*Field.*

"Nothing can be more complete than the account of the scientific results of these voyages, which are fully illustrated by woodcuts of the strange forms of life brought from the dark depths of the ocean, by charts of soundings, and elaborate tables of the deep-sea temperature. The book is another admirable example of that mingling of literary interest with scientific completeness and value which is the only true form of what is called in lumbering but expressive phrase, 'the popularisation of science."—*Daily News.*

MACMILLAN & CO., LONDON.

SCOTTISH PROVIDENT INSTITUTION,

EDINBURGH: 6, St. Andrew Square. LONDON: 18, King William Street, E.C.

ITS ADVANTAGES over other offices are:—

A larger immediate assurance for the same premium, with the prospect to good lives of eventually receiving very considerable additions.

Thus £1,200 or £1,250 may be secured at once for the premium usually charged for £1,000 only; and policies originally for, say, £1,000, have been increased to £1,400, £1,600, or even to £1,800.

FINANCIAL POSITION.

The Fund, accumulated entirely from the premiums, exceeds £2,250,000. Notwithstanding its low rates, no Office of the same age (Established 1837) has so large a Fund, or shows so large an increase from year to year.

On May 1st, Part I., super royal 8vo., price 3s., of a Third Issue of

BRITISH WILD FLOWERS. Illustrated

by J. E. SOWERBY, with short descriptions and references.

This work will be completed in 22 monthly parts. Each part will contain coloured Illustrations of 80 wild flowers on 4 plates.

The volume is a condensed edition of the "Standard English Botany" of Sowerby and Sir James Edward Smith, and contains a coloured illustration of every British plant.

JOHN VAN VOORST, 1, Paternoster Row

8vo. cloth, 474 pp., illustrated by 160 Woodcuts, £1 6s.

A HISTORY of BRITISH QUADRUPEDS,

including the Cetacea. By THOMAS BELL, F.R.S. &c. Second Edition, revised and partly re-written by the Author, assisted by R. F. Tomes and E. R. Alston.

"The work as a whole contains a fund of interesting information with which every English gentleman, whether living in town or country, should be familiar. We need scarcely add that the drawings, as in all Mr. Van Voorst's publications, are exquisitely done, and add greatly to the value of the work."—*Academy*, April 4, 1874.

JOHN VAN VOORST, 1, Paternoster Row.

In 8vo, with 12 Plates, price 21s. cloth.

THE OCEAN: its Tides and Currents and their Causes.

By WILLIAM LEIGHTON JORDAN, F.R.G.S.

"A very valuable addition to the list of works advancing our cosmical knowledge."—*Scientific Review*.

"The author of this book gives us a new Principia. Still, the book is the production of a man thoroughly well up in his own subject, and many others collateral with it. It is one that may be safely commended to the study of all who are interested in the subject of ocean currents."—*Iron*.

"Here we have the vulnerable point of Dr. Carpenter's modified resuscitation of the old theory of oceanic circulation clearly indicated, and a home-thrust of clear, sound reasoning fairly delivered through it. As this point is the very heart of Dr. Carpenter's contribution to the subject, the thrust is fatal. It is followed by further and equally clear and able discussion of the details of Dr. Carpenter's arguments, and of the theories of Maury, Rennell, Herschel, &c. This Chapter XX of Mr. Jordan's book is really excellent, and worthy of careful reading."—*Quarterly Journal of Science*.

The reports received from H.M.S. *Challenger* are confirming the views expressed in this work with a distinctness exceeding the most sanguine anticipations of the Author.

London: LONGMANS, GREEN, & CO., Paternoster Row.

NEW WORK BY RICHARD A. PROCTOR, B.A.

Just published, in 8vo, illustrated by 22 Lithographic Charts (4 coloured) and 22 Woodcut Diagrams, price 16s.

THE UNIVERSE AND THE COMING TRANSITS:

Presenting Researches into and New Views respecting the Constitution of the Heavens, together with an Investigation of the Conditions of the approaching Transits of Venus. (Recently confirmed by a unanimous vote of the chief Astronomers of Great Britain.) By RICHARD A. PROCTOR, B.A., Honorary Fellow of King's College, London.

"One of the most exhaustive of modern astronomical treatises."—*Standard*.

"We heartily commend this book to the attention of our readers; its style is plain, but its matter and substance will gratify their utmost expectations of the grand and the sublime."—*Edinburgh Courant*.

London: LONGMANS, GREEN, & CO., Paternoster Row.

Published by Georg Reimer, Berlin.

UNTERSUCHUNGEN uber die VEGETATIONSFORMEN von COCCOBACTERIA SEPTICA

und den Antheil, welchen sie an der Entstehung und Verbreitung der accidentellen Wundkrankheiten haben. Versuch einer wissenschaftlichen Kritik der verschiedenen Methoden antiseptischer Wundbehandlung. Von Dr. THEODOR BILLROTH, Professor der Chirurgie in Wien. 258 pp. and 5 plates, royal 4to. boards, 48s.

London: WILLIAMS & NORGATE, 14, Henrietta Street, Covent Garden. Edinburgh: 20, South Frederick Street.

BY DR. LIONEL BEALE, F.R.S.

1. **PROTOPLASM.—I. Dissentient. II Demonstrative. III Speculative.** 3rd Edition, 16 Coloured Plates, 10s. 6d. [*Now ready*.
2. **BIOPLASM, or Living Matter. 22 Plates.** 6s. 6d.

London: J. & A. CHURCHILL.
Philadelphia: LINDSAY & BLAKISTON.

Now ready, price 12s., royal 4to, bevelled cloth, gilt edges.

PHEASANTS FOR COVERTS AND AVIARIES,

their Natural History and Practical Management. By W. B. TEGETMEIER, F.Z.S. Illustrated with numerous Full-page Engravings by T. W. Wood.

"One of the handsomest and most useful sporting-books published."—*Baily's Magazine*.

"Nothing can be more interesting than the descriptions."—*Athenæum*.

"Mr. Tegetmeier has conveyed an amount of information which is truly surprising."—*Lancet*.

"Replete with practical detail."—NATURE.

"No one will regret that Mr. Tegetmeier's skill has been directed into this channel."—*Saturday Review*.

"We have not only all the scientific knowledge we possess of the pheasant, but every needful detail of instructions how to breed and rear it."—*Standard*.

London: *Field* Office, 346, Strand, W.C.

Now ready, with illustrations, crown 8vo, 12s.

RECORDS OF THE ROCKS; or, Notes

on the Geology, Natural History, and Antiquities of North and South Wales, Devon, and Cornwall. By Rev. W. S. SYMONDS, F.G.S., Rector of Pendock.

"We are sure that Mr. Symonds' book, while it will serve as a very useful itinerary for geologists on their rambles, will be still more welcome to the more discursive naturalist, and to the ordinary tourist, on account of the variety of fields over which it conducts him.

"A tourist who has been fortunate enough to put this book in his portmanteau when exploring the districts of which it treats, will certainly be at no loss for interesting and valuable local information of every kind."—*Saturday Review*.

"That which distinguishes the 'Records of the Rocks' from the crowd of geological books which bear a superficial resemblance to it, is that it is the record of the personal experiences of an amateur who has laboured in his favourite pursuit for many years with a diligence and conscientiousness seldom to be met with out of the line of professional study."—*Guardian*.

"An excellent work. The author is an amateur of unusual earnestness, experience, and attainments, and his book is one which those unversed in geology and natural history may read with pleasure and profit. Visitors in the counties of which the author treats will enjoy their vacation all the more with this volume."—*Daily News*.

JOHN MURRAY, Albemarle Street.

Eighth Thousand, cloth, 21s., 70 Plates, 4 Coloured.

HOW TO WORK WITH THE MICROSCOPE.

A complete Manual of Microscopical Manipulation. A full description of many new processes of investigation, taking photographs, &c.

HARRISON, Pall Mall.

Now ready, crown 8vo, price 5s. 6d.

SANITARY ARRANGEMENTS FOR DWELLINGS,

intended for the Use of Officers of Health, Architects, Builders, and Householders. With numerous Illustrations. By WILLIAM EASSIE, C.E., F.L.S., F.G.S. &c., Author of "Healthy Houses."

London: SMITH, ELDER, & CO, 15, Waterloo Place.

MACMILLAN'S MAGAZINE.

No. 175. FOR MAY.

PRICE 1s.

CONTAINS—

1.—"Our First Great Novelist." By George Barnett Smith.
2.—"Castle Daly. The Story of an Irish Home Thirty Years Ago." Chapters VIII—X.
3.—"Mendelssohn." By Dr. Ferdinand Hiller. Translated by M. E. von Glehn. Conclusion.
4.—"Life or Death." By E. B.
5.—"A Ride through the Bazaar at Yarkund." By Capt. E. T. Chapman, R.A.
6.—"Dante." By Rev. M. Creighton. Part II.
7.—"Ordered South." By Robert Louis Stevenson.
8.—"More about Vermont."
9.—"A Visit to a German Girls' School." By Mrs. Sandford.
10.—"Laid at Rest." By Isa Craig Knox.

MACMILLAN & CO., London.

DIARY OF SOCIETIES.

LONDON

THURSDAY, MAY 7.

ROYAL SOCIETY, at 8.30 —Preliminary Experiments on a Magnetised Copper Wire: B. Stewart, F.R.S., and A. Schuster —Addition to the Paper on Volcanic Energy, an Attempt to Develop its True Origin and Cosmical Relations: R. Mallet, F.R.S —Note on some Winter Thermometric Observations in the Alps: Dr Frankland, F.R.S.

SOCIETY OF ANTIQUARIES, at 8.30 —On Statutes of Chichester Cathedral: E. C. Walcott, F.S.A.

CHEMICAL SOCIETY, at 8.—On the Constitution of Urea: Dr. D Tommasi Researches on the Action of the Copper-Zinc Couple on Organic Bodies: Part VII. On the Chlorides of Ethylene and Ethylidene: Dr J. H. Gladstone and A. Tribe.—On a Mineral from New Caledonia: A. Liversidge

LINNEAN SOCIETY, at 8 —Atlantic Crustacea from the *Challenger* Expedition: Dr. V. Willemoes-Suhm —On a new Atlantic Sphæromid, &c: Rev T. R. R Stebbing.—Descriptions of Five new species of *Gonyleptes*: A. G. Butler.

ROYAL INSTITUTION, at 3.—The Atmosphere: W. N. Hartley.

FRIDAY, MAY 8.

ROYAL INSTITUTION, at 9.—Historical Enigmas in the Trial of Galileo: Sedley Taylor.

JUNIOR PHILOSOPHICAL SOCIETY, at 8.—Multiple and Coloured Stars: F. W. H. Preston.

SOCIETY OF ARTS, at 8.—Sugar Refining: Dr Griffin.

SATURDAY, MAY 9.

PHYSICAL SOCIETY, at 3 —On Certain Physical Properties of Ice Dr Rae. —On the Fall in Pitch occurring in Strained Wires through which a Galvanic Current is passing: Dr. Stone.—On an Absolute Galvanometer: Prof. Guthrie.

ROYAL INSTITUTION, at 3.—The Planetary System: R. A. Proctor.

MONDAY, MAY 11.

GEOGRAPHICAL SOCIETY, at 8.

SOCIETY OF ARTS, at 8 —Cantor Lecture; On Carbon and Certain Compounds of Carbon: Prof. Barth

TUESDAY, MAY 12.

ANTHROPOLOGICAL INSTITUTE, at 8.—On Statistics obtained from Schools: Francis Galton, F.R.S —On the Excess of Female Population in the West Indies Francis Galton, F.R.S.—On the Extinction of Families · Rev H. W Watson —On Ancient Stone Monuments of the Nágás: Major H. Godwin-Austen, F.R.G.S

ROYAL INSTITUTION, at 3 —The Nervous System: Prof Rutherford.

PHOTOGRAPHIC SOCIETY, at 8

HORTICULTURAL SOCIETY, at 2.—Meeting of Council.

WEDNESDAY, MAY 13

GEOLOGICAL SOCIETY, at 8 —Note on some of the Generic Modifications of the Plesiosaurian Pectoral Girdle: Harry G. Seeley, F.L.S —*Murænosaurus leedsii*, a Plesiosaurian from the Oxford Clay: Harry G Seeley, F.L.S —On the Remains of Labyrinthodonta from the Keuper Sandstone of Warwick, preserved in the Warwick Museum. L. C. Miall.

SOCIETY OF TELEGRAPH ENGINEERS, at 8

HORTICULTURAL SOCIETY.—Show of Pot Roses.

SOCIETY OF ARTS, at 8 —On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge: Major-General Synge.

THURSDAY, MAY 14.

ROYAL INSTITUTION, at 3.—Crystals: N. S. Maskelyne

MATHEMATICAL SOCIETY, at 8 —On the Correlation of two Planes: Dr. Hirst, F.R.S., President —On the Contact of Quadrics with other Surfaces W. Spottiswoode, Treas R.S

EDINBURGH

THURSDAY, MAY 14.

GEOLOGICAL SOCIETY, at 8.30.—On an Analysis of a *Lepidodendroid* plant in Shale, with Remarks on the Formation of Coal: John Gellatly —Notice of a large Quartz Boulder, called "The White Stone," in the Town of Peebles · Ralph Richardson —Exhibition of Specimens of *Holoptychius nobilissimus* from the Black Hill, near Melrose: Charles W. Peach, —Closing Address On the Probability of our successfully calculating the Antiquity of the Earth: Andrew Taylor.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft × 1 ft. square), which serves as a Stand for the instrument to work on	£12 0 0
Reflectors for projecting the Figures on the Screen	2 12 6
N B.—Specimen Curves, on card, post free ... per dozen...	0 3 0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0 7 6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0 3 6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr Tyndall at the Royal Institution ...	£5 5 0

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c, by simply dipping them in a solution of JUDSON'S DYES Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades

JUDSON'S DYES.—For Staining Wood.—Diluted with Water They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent, No 2 Black for walnut, Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO, PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U S.A.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations.

Conducted by H. G KNAGGS, M.D. F.L.S., R. McLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N B.—Communications, &c., should be sent to the Editors at the above address.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S, Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 10*s* 6*d* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, S.W.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co, Stationers' Hall Court.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B, F.L.S, British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s.* post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16*s.* 6*d.* bound in cloth): also covers for the volume (price 1*s.*), and back numbers.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle. —*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and meat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST.

A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading.

Price 6*d.* per month, or 5*s.* per annum, Post Free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED FROM AN ACRE OF SOIL by an Average Crop of Wheat, Oats, Barley, Turnips, &c; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London; 176, FLEET STREET, E C., and 47, MILLBANK STREET, S.W.

This day, in 8vo, price 7s. 6d.

THEORY of the GLACIERS of SAVOY.

BY M. LE CHANOINE RENDU,

TRANSLATED BY ALFRED WILLS, Q.C.

LATE PRESIDENT OF THE ALPINE CLUB.

TO WHICH ARE ADDED THE ORIGINAL MEMOIR, AND SUPPLEMENTARY ARTICLES BY

PROFESSOR TAIT and JOHN RUSKIN, D.C.L.,

EDITED, WITH INTRODUCTORY REMARKS, BY

GEORGE FORBES, B.A.,

Professor of Natural Philosophy in the Andersonian University, Glasgow.

In 8vo, price 16s.

THE LIFE AND LETTERS OF JAMES DAVID FORBES, F.R.S.,

LATE PRINCIPAL OF THE UNITED COLLEGE IN THE UNIVERSITY OF ST. ANDREWS.

BY JOHN CAMPBELL SHAIRP, LL.D.

PRINCIPAL OF THE UNITED COLLEGE IN THE UNIVERSITY OF ST. ANDREWS;

PETER GUTHRIE TAIT, M.A.

PROFESSOR OF NATURAL PHILOSOPHY IN THE UNIVERSITY OF EDINBURGH;

AND

A. ADAMS-REILLY, F.R.G.S.

With Portraits, Maps, and Illustrations.

"It has seldom been our good fortune to peruse a biography so entirely satisfactory as that contained in the present volume. There were a wonderful simplicity and unity in the character and career of Principal Forbes, and in this delightful memoir the living man is so faithfully represented, that those who had only known him as the indefatigable physicist, the demonstrator, if not the actual discoverer of the phenomena of glacier structure and motion, or those whom his career never reached, will here find themselves introduced to a personal acquaintance; while his many friends and loyal students will gratefully acknowledge that Prof. Shairp and his able coadjutors have done their work wisely and well. At once a graceful literary monument to the memory of a good man, and an exhaustive scientific manual on the special subjects to which Forbes's life was consecrated."—*Spectator.*

MACMILLAN AND CO., London.

HOLLOWAY'S PILLS.—During spring, before entering on the relaxing heat of summer, it is a wise and wholesome precaution to purify and cool the system by some alterative competent to regulate disordered actions, and to strengthen while it cleanses. This long-sought medicine exists in Holloway's far-famed, purifying, and tonic Pills, which cost only a trifle, and will ward off serious illness, which too frequently reduces competency to poverty, and enjoyment to misery. This medicine, both innocent in its nature and searching in its operation, is suitable for all ages and both sexes. It is especially adapted for soldiers and sailors, and is an indispensable requisite for colonists and persons proceeding to foreign countries, where climates harass the constitution

BRYANT & MAY'S

MATCHES.

PRICE EIGHTEENPENCE.

THE PRACTITIONER:

A Monthly Journal of

THERAPEUTICS.

Edited by FRANCIS E. ANSTIE, M.D., F.R.C.P., Senior Assistant Physician to Westminster Hospital, and Lecturer on Materia Medica in Westminster Hospital School.

No LXXI. for MAY 1874, Contains—

Original Communications:—

The EDITOR.—"The *Spectator* and the Vivisection Question"

EDGAR A. BROWNE.—"A Method of Treating Tinea Tonsurans"

FREDERICK T. ROBERTS, M.D. B.Sc. M.R.C.P.—"On 'Rest' in the Treatment of Chest Affections."

DR ANSTIE.—"On Tissue-destruction in the Febrile State, and its Relations to Treatment"

T. LAUDER BRUNTON, M.D. Sc.D.—"On the Action of Purgative Medicines"

DR CHARLES JAMES CAMPBELL.—"On Obstetrical Effort during Chloroformic Anæsthesia"

Reviews, Clinic of the Month, Extracts from British and Foreign Journals

DEPARTMENT OF PUBLIC HEALTH.

The Prospects of Public Health By H. W. Rumsey, M.D.—The Medical Officers of Health for combined Sanitary Districts.

MACMILLAN & CO., 29 & 30, Bedford Street, Covent Garden, London

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

PERUVIAN GOVERNMENT GUANO.

MESSRS. J. HENRY SCHRODER & CO.,
OF EAST INDIA AVENUE, AND 15, LEADENHALL STREET, LONDON,
Hereby Give NOTICE that they are now the SOLE CONSIGNEES of this GUANO in the United Kingdom.
The price is 13*l.* per ton, for lots of not less than 30 tons, or 14*l.* 5*s.* per ton for any smaller quantity.
Prompt cash, per ton in bags, gross weight at any of their depôts.
Further particulars may be ascertained on application to them or to their Agents—
Messrs. J. H. SCHRODER & CO., 13, Rumford Place, Liverpool;
Messrs. WM. SMITH & CO., 10, Corn Street, Bristol, and at King's Lynn;
Messrs. EDWARDS, WINKLEY, & CO., 160, High Street, Hull;
Mr. J. CAMERON SWAN, 1, Dean Street, Newcastle-on-Tyne.

DISSOLVED PERUVIAN GUANO,
PREPARED BY
OHLENDORFF & CO.
LONDON, ANTWERP, HAMBURGH, AND EMMERICH-ON-RHINE.

GUARANTEED TO CONTAIN
Nitrogen equal to 10 per cent. of non-volatile Ammonia.
20 „ soluble } Guano Phosphates.
4 „ insoluble }
Price :—14*l.* per ton for 30 tons and upwards.
15*l.* „ lots under 30 tons.
Delivered free at any of their depôts in the United Kingdom
AGAINST CASH.

This Manure is prepared from GENUINE PERUVIAN GOVERNMENT GUANO. The result of its special treatment is, that the ammonia is FIXED, the phosphates in the raw Guano rendered SOLUBLE and the Manure brought into the condition of a free dry powder.

It loses nothing from exposure to the atmosphere, or to the heat of the sun. It is offered to the Farmer with a Guarantee of its composition, and is, in fact, the richest, and, considering the quality, the cheapest GUARANTEED Manure at present in the market. Its fertilising properties are such as will enable the consumer to derive the greatest economical advantage from the use of Guano.

OHLENDORFF & CO.

OFFICES :—110, Fenchurch Street, London, E.C.
WORKS :—At Plaistow, near Victoria Docks.
DEPOTS :—In London, at the above Works, and at the principal Outports.

Now Ready. Price One Shilling.

ART
PICTORIAL AND INDUSTRIAL: A REVIEW.
FOR MAY 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.
"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF MAY NUMBER—Our Illustrations :—1. "The Beheading of St. John," by Puvis de Chavannes. 2. "Lady Sitting Before an Easel Picture," by M. Corot. 3. "After the Bath," by Corot. "The Age of Innocence," by Samuel Cousins, R.A., after Sir Joshua Reynolds.—The Exhibitions : The Society of Painters in Water Colours, the Institute of Painters in Water Colours, the Society of French Artists, New Bond Street.—Art Notes and Gossip.—Review.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London : SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, May 7, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 237, Vol. 10] THURSDAY, MAY 14, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

LONDON INTERNATIONAL EXHIBITION, 1874.

OPEN DAILY, 10 a m to 6 p.m.

A MILITARY BAND

PLAYS in the FRENCH GARDEN on THURSDAYS, from Three to Five, and in the WESTERN ANNEXE on SATURDAYS, from Three to Five.

ORGAN PERFORMANCE DAILY

In the ROYAL ALBERT HALL, from Four to Five.

THE EXHIBITION OF WINE

(Tasting permitted)

Is OPEN DAILY from Twelve to Five. Season Ticket holders are admitted without extra charge. Other Visitors to the Exhibition will be charged 6d extra for admission to the Cellars of the Royal Albert Hall. Entrance Kensington Road.

LONDON INTERNATIONAL EXHIBITION.

SEASON TICKETS.

A. Non-transferable Ticket … … … … … … … …	£2
B. Non-transferable Ticket, with 120 artisans', or 240 school tickets … … … … … … … … … … … … …	£3
C. Transferable Ticket, with 200 artisans' or 400 school tickets	£5

CHARGES FOR ADMISSION.—1s. daily, except on Wednesdays, 2s. 6d.

LONDON INTERNATIONAL EXHIBITION.—WHIT MONDAY.

GRAND POPULAR SONG AND BALLAD CONCERT, with HUNGARIAN BAND and TYROLESE SINGERS, in the Royal Albert Hall, at 3 p m.

VISITORS to the EXHIBITION will be entitled to a REDUCTION of ONE SHILLING from the price of CONCERT TICKETS, and will be ADMITTED FREE of EXTRA CHARGE to the GALLERY.

ZOOLOGICAL SOCIETY of LONDON.

—The following LECTURES will be given in the Picture Gallery, in the Society's Gardens, Regent's Park, at 5 p.m.

Tuesday, May 19 } "On the Aquarium and its Inhabitants."
Friday, May 22 } By W. B. Carpenter, M.D. F.R.S.

These Lectures will be free to Fellows of the Society and their Friends and to other Visitors to the Gardens.

PRELIMINARY EXAM. IN ARTS, COLL SURG., June 1874.

MR. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, will shortly begin to read with Classes for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has passed several Pupils for this Examination, to whom references are allowed An early Class will commence towards the latter part of February, and a later one about Lady Day Fee for the Course, from 7 to 12 guineas, according to the time of commencement and number of subjects taken up —Address, 24 Old Square, Lincoln's Inn, W.C.

MATRICULATION EXAMINATION, LOND. UNIV., June 1874

MR. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, reads with Pupils for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Examination, having passed fifty-three Pupils, to whom references can be given An early class about Lady-day, and a later one will commence the middle of February. Fees for the two, 14l and 10l 10s respectively For further particulars, address to 24, Old Square, Lincoln's-inn, W C Two of Mr. Hanbury's pupils passed the Matriculation Examination in January 1873, in the Honours list, seventh and fourteenth respectively.

A few Residents can be accommodated in Mr. Hanbury's house, at Clapham.

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

TO NATURALISTS and GEOLOGISTS.

In the River Marshes near the picturesque ruin of Orford Castle, Suffolk, a lately made cutting in the Crag formation is bringing to light numerous Fossils, including some of the rarer species in a high state of preservation, and arrangements are now being made by means of a small Subscription from Naturalists who may wish to possess sets of these Fossils to secure as many of them as possible while the cutting is open The collecting operation, and the labelling the Fossils will be done under the direction of Mr. Charlesworth, while details can be had by written application (with stamped envelope) to Fredc Collingwood, Esq, F.G S., 4, St. Martin's Place, Trafalgar Square, W.C.

SCIENTIFIC BOOKS.—A few copies can

still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Conchólorum, Tankerville Cat, &c, &c, as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c. &c. SOWERBY, 167A, Strand.

REQUIRED, a MATHEMATICAL and NATURAL SCIENCE MASTERSHIP in a good School, by a CAMBRIDGE HONOUR-MAN.—Address—Alpha, care of the Publishers of NATURE, 29, Bedford Street, Strand, W.C.

NATURAL SCIENCE MASTERSHIP WANTED after July 31 next by a Graduate of Cambridge, in a first-rate Grammar School. The highest testimonials.—Address, M.A., care of NATURE, 29, Bedford Street, Covent Garden, London, W.C.

A YOUNG LADY seeks a RE-ENGAGEMENT as GOVERNESS in London. She is capable of teaching the rudiments of NATURAL SCIENCE, and has a thorough knowledge of French, German, and the usual branches of a sound English Education. —Address, Miss K., NATURE Office, 29, Bedford Street, Strand, W.C.

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS. Must all be well authenticated.—Apply, stating terms, to E. E. B., care of Messrs. MACMILLAN and Co., Bedford Street, Strand, W.C.

WANTED.—An Oxyhydrogen Lantern, complete and in good condition.—Apply, W.H., 108, Upper Conduit Street, Leicester.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

FOR SALE.—A Bound Set of the Philosophical Transactions of the Royal Society. From 1750 to 1755, and 1801 to 1869.—Apply to F. D. M., care of Noel Hartley, Esq., King's College, London.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

ODONTOPTERYX TOLIAPICUS (Owen).—Casts of the Head of this new rare Bird from the London clay of Sheppey, described by Prof. Owen, and formerly in the possession of Mr Bryce M Wright, can now be procured. Price 2s. 6d. each; coloured, 4s. BRYCE M. WRIGHT, Dealer in Minerals, Fossils, Shells, Ethnological and Ethnographical Implements, 90, Great Russell Street, Bloomsbury, London.

SALMON, ODY, & CO.,

MANUFACTURERS OF

TRUSSES AND ELASTIC STOCKINGS,

OF THE

BEST MATERIALS & WORKMANSHIP ONLY.

AT MODERATE PRICES.

To his late Majesty William the Fourth, and to Her Majesty's Army and Navy.

292, STRAND, LONDON. ESTABLISHED A.D. 1806.

N.B.—Ladies' Abdominal Belts.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided, a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly,

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
,, Double ,, 31s. 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s. and 52s. 6d.
} Post-free

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

NATURAL SCIENCE.—An Associate of Royal School of Mines, Whitworth Scholar, and Forbes' Medallist, is open to an Appointment in Chemistry, Physics, or Biology.—Address, A.R.S.M., Publisher of NATURE, 29, Bedford Street, Strand, W.C.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the Instrument to work on	£12 0 0
Reflectors for projecting the Figures on the Screen	2 12 6
N.B.—Specimen Curves, on card, post free ... per dozen...	0 3 0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0 7 6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0 3 6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

JAMES WOOLLEY, SONS, & CO.,
69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,

For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS

For the various Public Examinations.

Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,
Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

Now ready,

NEGRETTI & ZAMBRA'S

NEW ENCYCLOPÆDIC CATALOGUE

Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard

METEOROLOGICAL INSTRUMENTS,

Containing very numerous Comparative Tables of Reference, and illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s. 6d.

NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,
HOLBORN VIADUCT,
45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 ,, ...	One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS
COCOA

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied Of all Chemists and Stationers

JUDSON'S DYES.—Dyeing at Home.—
JUDSON'S simple DYES are most useful and effectual Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper
Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES. — Ferns, Grasses,
Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A
Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water

JUDSON'S DYES.—For Colouring Architectural Plans, &c —Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades

JUDSON'S DYES.—For Staining Wood.—
Diluted with Water They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent, No. 2 Black for walnut, Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

HOLLOWAY'S OINTMENT and PILLS.
—Self Help —In sickness it was a momentous matter to find an easy, ready, and reliable remedy for outward disfigurations and inward disorders until these inestimable preparations were made known. No invalid need now be at a loss in successfully managing ulcers, sores, tumours, boils, bruises, sprains, &c. Enveloping Holloway's medicines are very intelligible printed directions for using them, which should be attentively studied and immediately followed by all who resort to His treatment Sooner or later the sufferer will assuredly triumph over the worst diseases. This searching Ointment disperses all those malignant humours which aggravate diseases of the skin, prevent the cicatrization of ulcers, and ever kindle inflammatory tendencies in the system.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF
AGRICULTURE JOURNAL
AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.
The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d*, or prepaid, 15*s*. a year post free

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S, Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c., and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening
Trees and Shrubs
Hardy Flowers
Town Gardens.
The Conservatory.
Public Gardens
The Greenhouse and Stove.
The Household
The Wild Garden
The Kitchen Garden

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d*. per Copy. It may also be had direct from the Office at 5*s* for a Quarter, 9*s* 9*d* for a Half-year, and 19*s*. 6*d* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d*.

37, Southampton Street, Covent Garden, S.W.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F Z S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists;" those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History The editor has been assisted by more than two hundred of our very best zoologists

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations.

Conducted by H. G KNAGGS, M.D. F.L.S, R. MCLACHLAN, F.L S, E. C. RYE, and H. T. STAINTON, F.R.S, &c

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.
Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.
Vols I to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10*s*. each, the succeeding vols. may be had separately or together at 7*s*. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B —Communications, &c., should be sent to the Editors at the above address.

SCOTTISH PROVIDENT INSTITUTION,

EDINBURGH: 6, St. Andrew Square, LONDON: 18, King William Street, E.C.

ITS ADVANTAGES over other offices are:—

A larger immediate assurance for the same premium, with the prospect to good lives of eventually receiving very considerable additions.

Thus £1,200 or £1,250 may be secured at once for the premium usually charged for £1,000 only; and policies originally for, say, £1,000, have been increased to £1,400, £1,600, or even to £1,800.

FINANCIAL POSITION.

The Fund, accumulated entirely from the premiums, exceeds £2,250,000. Notwithstanding its low rates, no Office of the same age (Established 1837) has so large a Fund, or shows so large an increase from year to year.

PERUVIAN GOVERNMENT GUANO,

MESSRS. J. HENRY SCHRODER & CO.,

OF EAST INDIA AVENUE, AND 15, LEADENHALL STREET, LONDON,

Hereby Give NOTICE that they are now the SOLE CONSIGNEES of this GUANO in the United Kingdom.

The price is 13*l.* per ton, for lots of not less than 30 tons, or 14*l.* 5*s.* per ton for any smaller quantity.

Prompt cash, per ton in bags, gross weight at any of their depôts.

Further particulars may be ascertained on application to them or to their Agents—

Messrs. J. H. SCHRODER & CO., 13, Rumford Place, Liverpool;
Messrs. WM. SMITH & CO., 10, Corn Street, Bristol, and at King's Lynn;
Messrs. EDWARDS, WINKLEY, & CO., 160, High Street, Hull;
Mr. J. CAMERON SWAN, 1, Dean Street, Newcastle-on-Tyne.

DISSOLVED PERUVIAN GUANO,

PREPARED BY

OHLENDORFF & CO.

LONDON, ANTWERP, HAMBURGH, AND EMMERICH-ON-RHINE.

GUARANTEED TO CONTAIN

Nitrogen equal to 10 per cent. of non-volatile Ammonia.
20 „ soluble } Guano Phosphates.
4 „ insoluble } Guano Phosphates.
Price:—14*l.* per ton for 30 tons and upwards.
15*l.* „ lots under 30 tons.

Delivered free at any of their depôts in the United Kingdom

AGAINST CASH.

This Manure is prepared from GENUINE PERUVIAN GOVERNMENT GUANO. The result of its special treatment is, that the ammonia is FIXED, the phosphates in the raw Guano rendered SOLUBLE and the Manure brought into the condition of a free dry powder.

It loses nothing from exposure to the atmosphere, or to the heat of the sun. It is offered to the Farmer with a Guarantee of its composition, and is, in fact, the richest, and, considering the quality, the cheapest GUARANTEED Manure at present in the market. Its fertilising properties are such as will enable the consumer to derive the greatest economical advantage from the use of Guano.

OHLENDORFF & CO.

OFFICES:—110, Fenchurch Street, London, E.C.
WORKS:—At Plaistow, near Victoria Docks.
DEPOTS:—In London, at the above Works, and at the principal Outports.

BY DR LIONEL BEALE, F R S.

1. PROTOPLASM.—I. Dissentient. II. Demonstrative III. Speculative. 3rd Edition, 16 Coloured Plates, 10*s* 6*d* [*Now ready.*

2. BIOPLASM, or Living Matter. 22 Plates. 6*s.* 6*d.*

London: J. & A. CHURCHILL
Philadelphia: LINDSAY, & BLAKISTON.

JUST PUBLISHED.

A SUMMARY of Mr. HERBERT SPENCER'S "FIRST PRINCIPLES" (published at 16*s.*) FOR ONE SHILLING.

F. PITMAN, 20, Paternoster Row, London.

NOTICE.

The SECOND EDITION of Mr. George HENRY LEWES'S PROBLEMS of LIFE and MIND. First Series: The Foundations of a Creed. Vol. I. will be ready at all Booksellers' and Libraries in a few days.

London: TRÜBNER & CO., 57 and 59, Ludgate Hill.

NEW WORK BY RICHARD A. PROCTOR, B A.

Just published, in 8vo, illustrated by 22 Lithographic Charts (4 coloured) and 22 Woodcut Diagrams, price 16*s*.

THE UNIVERSE AND THE COMING TRANSITS: Presenting Researches into and New Views respecting the Constitution of the Heavens; together with an Investigation of the Conditions of the approaching Transits of Venus. (Recently confirmed by a unanimous vote of the chief Astronomers of Great Britain.) By RICHARD A. PROCTOR, B.A., Honorary Fellow of King's College, London.

"One of the most exhaustive of modern astronomical treatises."—*Standard.*

"We heartily commend this book to the attention of our readers; its style is plain, but its matter and substance will gratify their utmost expectations of the grand and the sublime."—*Edinburgh Courant.*

London: LONGMANS, GREEN, & CO., Paternoster Row.

Eighth Thousand, cloth, 21*s.*, 70 Plates, 4 Coloured.

HOW TO WORK WITH THE MICROSCOPE. A complete Manual of Microscopical Manipulation. A full description of many new processes of investigation, taking photographs, &c.

HARRISON, Pall Mall.

DIARY OF SOCIETIES.

LONDON

THURSDAY, MAY 14

ROYAL INSTITUTION, at 3.—Crystals : N S. Maskelyne
MATHEMATICAL SOCIETY, at 8 —On the Correlation of two Planes : Dr. Hirst, F.R S., President —On the Contact of Quadrics with other Surfaces · W Spottiswoode, Treas R.S —On Parallels of Developables : S Roberts —Rotating Sphere filled with Viscous Fluid : J. H. Rohrs.

FRIDAY, MAY 15.

ROYAL INSTITUTION, at 9.—The Steamship *Faraday* : Dr. C. W. Siemens.
MEDICAL MICROSCOPICAL SOCIETY, at 8
GEOLOGISTS' ASSOCIATION.—Excursion to Grays, Essex.

SATURDAY, MAY 16.

ROYAL INSTITUTION, at 3 —The Planetary System : R. A. Proctor.

MONDAY, MAY 18

SOCIETY OF ARTS, at 8 —Cantor Lecture ; On Carbon and Certain Compounds of Carbon : Prof. Barth.
VICTORIA INSTITUTE, at 8.—The Principle of Design in Nature : Prof. G Morris.

TUESDAY, MAY 19.

ZOOLOGICAL SOCIETY, at 8 30 —Notes on the respiration of some species of Indian fresh-water Fishes G. E Dobson.—On the habits of the Burrowing Owl (*Pholeoptynx cunicularia*) W. H. Hudson —Contributions to British Annelida. Part I. : W. C McIntosh.
ROYAL INSTITUTION, at 3 —The Nervous System . Prof. Rutherford.
STATISTICAL SOCIETY, at 7 45.—Statistics of Deaths by Suicide among British Troops W. H. Miller —The Elections of 1868 and 1874 : John Biddulph Martin.

WEDNESDAY, MAY 20

METEOROLOGICAL SOCIETY, at 7.—Some Remarks on the Estimation of Wind Force, and on the Relation between Pressure and Velocity : C O. F Cator.—On the Weather of Thirteen Winters : R Strachan —On a New Deep-Sea and Recording Thermometer : H. Negretti and J. W Zambra. —On a New Mercurial Minimum and Maximum Thermometer : S. G. Denton.

THURSDAY, MAY 21.

ROYAL INSTITUTION, at 3.—Crystals : N S Maskelyne.
CHEMICAL SOCIETY, at 8.—The Sewage Question from a Chemical point of view · W. N Corfield

EDINBURGH

THURSDAY, MAY 14.

GEOLOGICAL SOCIETY, at 8.30.—On an Analysis of a *Lepidodendroid* plant in Shale, with Remarks on the Formation of Coal : John Gellatly —Notice of a large Quartz Boulder, called "The White Stone," in the Town of Peebles Ralph Richardson —Exhibition of Specimens of *Holoptychius nobilissimus* from the Black Hill, near Melrose : Charles W. Peach, —Closing Address On the Probability of our successfully calculating the Antiquity of the Earth : Andrew Taylor.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

THE BREWERS' GUARDIAN :

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES ; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1871.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only Journal officially connected with brewing interests
Subscription, 16*s*. 6*d*. per annum, post free, dating from any quarter-day. Single Copies, 1*s*. each Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E C.

In 8vo, with 12 Plates, price 21*s* cloth.

THE OCEAN : its Tides and Currents and their Causes. By WILLIAM LEIGHTON JORDAN, F.R G S.

"A very valuable addition to the list of works advancing our cosmical knowledge."—*Scientific Review*.

"The author of this book gives us a new Principia. Still, the book is the production of a man thoroughly well up in his own subject, and many others collateral with it. It is one that may be safely commended to the study of all who are interested in the subject of ocean currents."—*Iron*

"Here we have the vulnerable point of Dr. Carpenter's modified resuscitation of the old theory of oceanic circulation clearly indicated, and a home-thrust of clear, sound reasoning fairly delivered through it As this point is the very heart of Dr Carpenter's contribution to the subject, the thrust is fatal. It is followed by further and equally clear and able discussion of the details of Dr Carpenter's arguments, and of the theories of Maury, Rennell, Herschel, &c This Chapter XX. of Mr Jordan's book is really excellent, and worthy of careful reading"—*Quarterly Journal of Science.*

The reports received from H M S *Challenger* are confirming the views expressed in this work with a distinctness exceeding the most sanguine anticipations of the Author.

London : LONGMANS, GREEN, & CO , Paternoster Row.

Now ready,

AN ELEMENTARY TREATISE ON STEAM. By JOHN PERRY, B E , Whitworth Scholar, F.C S., late Lecturer on Physics at Clifton College. 4*s* 6*d*

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light The numerous examples and exercises will prove useful in all Physics classes ; whether the whole course is followed or not ; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's Hill

MACMILLAN & CO., LONDON

INDIAN ORNITHOLOGY.

HUME'S STRAY FEATHERS ;

A Journal of Ornithology for India and its Dependencies Vol II Nos. 1, 2, 3. Edited by ALLAN HUME

8vo, 336 pp. sd. post-free, 21*s*. Calcutta, 1874.

CONTENTS :—

"In Memoriam" Edward Blyth.
"Die Papageien" of Otto Finsch.
The Islands of the Bay of Bengal —1. Physical Aspects, 2 Diary of our Trip, 3. Analysis of the Avifauna, 4. Detailed List of Species.
Novelties · Micronisus poliopsis, Propasser ambiguus.
Notes and Letters.

BERNARD QUARITCH, 15, Piccadilly, London

Just ready, Cheap Edition, 18mo, 1*s*.

The CHILDHOOD of the WORLD : a Simple Account of Man in Early Times. By EDWARD CLODD, F.R.A.S.

"This genial little volume is a child's book as to shortness, cheapness, and simplicity of style, though the author reasonably hopes that older people will use it as a source of information not popularly accessible elsewhere as to the life of Primitive Man and its relation to our own . . This book, if the time has come for the public to take to it, will have a certain effect in the world It is not a mere compilation from the authors mentioned in the preface, but takes its own ground and stands by itself and for itself. Mr. Clodd has thought out his philosophy of life, and used his best skill to bring it into the range of a child's view"—E. B. TYLOR, F R S, in NATURE.

"I read your little book with great pleasure. I have no doubt it will do good, and hope you will continue your work. Nothing spoils our temper so much as having to unlearn in youth, manhood, and even old age, so many things which we were taught as children. A book like yours will prepare a far better soil in the child's mind, and I was delighted to have it to read to my children."—Letter from Professor MAX MULLER to the Author

Now ready, price One Shilling.

"*NATURE*."

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s*. 6*d*.

Cloth Cases for binding all the volumes, price 1*s*. 6*d*. each.

Reading Cases to hold 26 numbers, price 2*s*. 6*d*.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

E. DENT & CO., 61, Strand, & 34, Royal Exchange.
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.
PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever
House Cistern, fitted with a Cistern Filter.
And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr Lankester, September 10, 1867; Dr Letheby, February 15, 1865, and December 1872.
Portable Cistern Filter.
Price £1 10s. and upwards. Portable Filters on this system, £1 5s to £3.
Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s. each.
Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.
Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.
The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.
Read "Water: its Impurities and Purification," price, per post, 2d.

Just Published. 8vo. Price 14s
A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS; OR, ORGANIC CHEMISTRY.
By C. SCHORLEMMER, F.R.S.,
LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.
London: MACMILLAN AND CO.

CADBURY'S COCOA ESSENCE.

CADBURY'S COCOA ESSENCE (Registered) is now taken by thousands as a light and invigorating beverage, who could not before take prepared Cocoa owing to its being too thick and heavy.

It consists solely of fine Cocoa Nibs, with the EXCESS of fatty matter extracted, and is consequently three times the strength of the "prepared" Cocoas so largely advertised, which often disagree with dyspeptic and delicate constitutions.

"Those who wish for Pure Cocoa in a convenient form should obtain the Cocoa Essence."—NATURE, Oct. 20, 1870.

"Cocoa treated thus will, we expect, prove to be one of the most nutritious, digestible, and restorative of drinks."—British Medical Journal, July 27, 1860.

CADBURY'S MEXICAN CHOCOLATE (IN BLUE WRAPPER) is guaranteed to consist solely of the finest Cocoa and Sugar, slightly flavoured with Vanilla. Great care has been taken in its preparation, so that it may be depended upon as the best Chocolate, used either as a confection or as a beverage.

OBSERVE.—*When Cocoa thickens in the cup it proves the addition of Starch.*

MAKERS, by Special Appointment, TO THE QUEEN.

Observe that "Cadbury's Cocoa Essence (Registered)" is on each Packet, as inferior descriptions are sometimes substituted

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & CO. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, May 14, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 238, Vol. 10] THURSDAY, MAY 21, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office

[All Rights are Reserved.

NATURE FOR JUNE 4

WILL CONTAIN NOTICE AND STEEL PORTRAIT OF THE EMINENT NATURALIST,

CHARLES DARWIN, F.R.S.

As this Number will have a LARGE EXTRA SALE, it offers unusual Advantages to ADVERTISERS

Advertisements should be sent to the Office as early as possible.

29, BEDFORD STREET, STRAND, W.C.

LONDON INTERNATIONAL EXHIBITION, 1874.

OPEN DAILY, 10 a.m. to 6 p.m.

A MILITARY BAND

Will PLAY in the FRENCH GARDEN at Three o'Clock on THURSDAYS and SATURDAYS.

ORGAN PERFORMANCE DAILY

In the ROYAL ALBERT HALL, from Four to Five.

THE EXHIBITION OF WINE

(Tasting permitted)

Is OPEN DAILY from Twelve to Five. Season Ticket holders are admitted without extra charge. Other Visitors to the Exhibition will be charged 6d. extra for admission to the Cellars of the Royal Albert Hall. Entrance Kensington Road.

LONDON INTERNATIONAL EXHIBITION.—WHIT MONDAY.

GRAND POPULAR SONG AND BALLAD CONCERT, with HUNGARIAN BAND and TYROLESE SINGERS, in the Royal Albert Hall, at 3 p.m.

VISITORS to the EXHIBITION will be entitled to a REDUCTION of ONE SHILLING from the price of CONCERT TICKETS, and will be ADMITTED FREE of EXTRA CHARGE to the GALLERY.

LONDON INTERNATIONAL EXHIBITION.

SEASON TICKETS.

A.	Non-transferable Ticket	£2
B.	Non-transferable Ticket, with 120 artisans', or 240 school tickets	£3
C.	Transferable Ticket, with 200 artisans' or 400 school tickets	£5

CHARGES FOR ADMISSION.—1s. daily, except on Wednesdays, 2s. 6d.

ROYAL INSTITUTION OF GREAT BRITAIN,

Albemarle Street, Piccadilly, W.

Dr. W. H. STONE will, on TUESDAY next, May 26, at Three o'clock, begin a Course of Two Lectures "On the Theory of Musical Instruments." With Musical Illustrations by eminent Artistes.

Subscription to this Course, Half-a-Guinea; to all the Courses of Lectures in the Season, Two Guineas.

LINNEAN SOCIETY, Burlington House,

Piccadilly, 12th May, 1874.—The ANNIVERSARY MEETING of this Society will be held here on MONDAY, the 25th of this month, at Three o'clock precisely, for the Election of a Council and Officers for the ensuing year.

FREDERICK CURREY, Secretary.

PRELIMINARY EXAM. IN ARTS, COLL. SURG., June 1874.

MR. HANBURY, M.A., Wrangler and late Senior Scholar of his College, will shortly begin to read with Classes for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has passed several Pupils for this Examination, to whom references are allowed. An early Class will commence towards the latter part of February, and a later one about Lady Day. Fee for the Course, from 7 to 12 guineas, according to the time of commencement and number of subjects taken up.—Address, 24 Old Square, Lincoln's Inn, W.C.

MATRICULATION EXAMINATION, LOND. UNIV., June 1874.

MR. HANBURY, M.A., Wrangler and late Senior Scholar of his College, reads with Pupils for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Examination, having passed fifty-three Pupils, to whom references can be given. An early class about Lady-day, and a later one will commence the middle of February. Fees for the two, 14l. and 10l. 10s. respectively. For further particulars, address to 24, Old Square, Lincoln's-inn, W.C. Two of Mr. Hanbury's pupils passed the Matriculation Examination in January 1873, in the Honours list, seventh and fourteenth respectively.

A few Residents can be accommodated in Mr. Hanbury's house, at Clapham.

SCIENTIFIC BOOKS.—A few copies can still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Concholorum, Tankerville Cat., &c., &c., as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c. &c. SOWERBY, 167A, Strand.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

REQUIRED, a MATHEMATICAL and NATURAL SCIENCE MASTERSHIP in a good School, by a CAMBRIDGE HONOUR-MAN.—Address—Alpha, care of the Publishers of NATURE, 29, Bedford Street, Strand, W.C.

To ASTRONOMERS and OTHERS.—A skillful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

NATURAL SCIENCE MASTERSHIP WANTED after July 31 next by a Graduate of Cambridge, in a first-rate Grammar School. The highest testimonials.—Address, M. A., care of NATURE, 29, Bedford Street, Covent Garden, London, W.C.

NATURAL SCIENCE.—An Associate of Royal School of Mines, Whitworth Scholar, and Forbes' Medallist, is open to an Appointment in Chemistry, Physics, or Biology.—Address, A.R.S.M., Publisher of NATURE, 29, Bedford Street, Strand, W.C.

A YOUNG LADY seeks a RE-ENGAGEMENT as GOVERNESS in London. She is capable of teaching the rudiments of NATURAL SCIENCE, and has a thorough knowledge of French, German, and the usual branches of a sound English Education. —Address, Miss K., NATURE Office, 29, Bedford Street, Strand, W.C.

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS. Must all be well authenticated.—Apply, stating terms, to E. E. B., care of Messrs. MACMILLAN and Co., Bedford Street, Strand, W.C.

COOKE'S EQUATORIAL REFRACTOR. Wanted, a 4½ or 5 in. Equatorial Refractor of excellent definition, by Cooke. One made by the *late* Mr. Cooke preferred.—Address, stating price, powers, and all other particulars, X.Y.Z., care of Mr. Hodges, Commerce Court, Sord Street, Liverpool.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X Y Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c., and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden
Landscape Gardening
The Fruit Garden
Garden Structures
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs
Hardy Flowers
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 10*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, S.W.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S., F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

Now ready, price 20*s.*

JOURNAL OF THE ROYAL GEOGRAPHICAL SOCIETY.

Vol. XLIII.

Edited by H. W. BATES, F.L.S., Assistant-Secretary.

CONTENTS.

1. On the Garo Hills. By Major H. H. Godwin-Austen, R.E.
2. On a Projected Railway Route over the Andes. By R. Crawford, C.E. (Map.)
3. Journey from Kiôto to Yedo. By C. W. Lawrence. (Map.)
4. Journey from Bandar Abbas to Mash-had, by Sistan, with some Account of the last-named Province. By Major-Gen. Sir F. J. Goldsmid, K.C.S.I. (Map.)
5. On Discoveries East of Spitzbergen, and Approaches towards the North Pole on the Spitzbergen Meridian. By C. R. Markham, C.B., F.R.S. (Map.)
6. Notes of a Journey in Southern Formosa. By J. Thomson. (Map.)
7. Narrative of a Journey through Western Mongolia. By Ney Elias, Jun. (Map.)
8. The Site of the Lost Colony of Greenland Determined, and Pre-Columbian Discoveries of America Confirmed from Fourteenth-Century Documents. By R. H. Major, F.S.A. (Four Maps.)
9. Recent Surveys in Sinai and Palestine. By Major C. W. Wilson, R.E. (Map.)
10. Recent Elevations of the Earth's Surface in the Northern Circumpolar Regions. By Henry Howorth.
11. Notes on M. Fedchenko's Map of Maghian. By R. Michell. (Map.)
12. Notes on Seistan. By Major-Gen. Sir H. C. Rawlinson, K.C.B. (Map.)
13. Report on the Country Around Aden. By Captain G. J. Stevens. (Map.)

⁂ Fellows are requested to apply for their Copies at the Offices of the Society, 1, Savile Row, Burlington Gardens, W.

JOHN MURRAY, Albemarle Street.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations.

Conducted by H. G. KNAGGS, M.D., F.L.S., R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10*s.* each; the succeeding vols. may be had separately or together at 7*s.* each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B., F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s.* post free in the United Kingdom) payable in advance to the publishers, Messrs. Reinken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16*s.* 6*d.* bound in cloth); also covers for the volume (price 1*s.*), and back numbers.

JAMES WOOLLEY, SONS, & CO.

69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,

For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS

For the various Public Examinations.

Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

SALMON, ODY, & CO.,

MANUFACTURERS OF

TRUSSES AND ELASTIC STOCKINGS,

OF THE

BEST MATERIALS & WORKMANSHIP ONLY.

AT MODERATE PRICES.

To his late Majesty William the Fourth, and to Her Majesty's Army and Navy.

292, STRAND, LONDON. ESTABLISHED A.D. 1806.

N.B.—Ladies' Abdominal Belts.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS;—W. BEST & SONS, Henrietta Street, Cavendish Square.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 "	One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

HOLLOWAY'S OINTMENT and PILLS.—Rheumatism and rheumatic gout are the most dreaded of all diseases, because their victims know that they are safe at no season, and at no age secure. Holloway's Ointment, after fomentation of the painful parts, gives greater relief than any other application, but it must be diligently used to obtain this desirable result. It has been highly commended by rheumatic subjects of all ages and of both sexes for rendering their attacks less frequent and less rigorous, and for repressing the sour perspirations and soothing the nerves. In many cases Holloway's Ointment and Pills have proved the greatest blessings in removing rheumatism and rheumatic gout which had assailed persons previously healthy and in the prime of life.

Now ready,

NEGRETTI & ZAMBRA'S

NEW ENCYCLOPÆDIC CATALOGUE

Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard

METEOROLOGICAL INSTRUMENTS,

Containing very numerous Comparative Tables of Reference, and illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s. 6d.

NEGRETTI AND ZAMBRA,

SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,

HOLBORN VIADUCT,

45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

BRYANT & MAY'S MATCHES.

Second Edition, royal 8vo, cloth extra gilt, 31s. 6d.

The DEPTHS of the SEA: An Account of the General Results of the Dredging Cruises of H M SS. *Porcupine* and *Lightning* during the Summers of 1868-69-70, under the Scientific Direction of Dr. Carpenter, F.R.S., J. Gwyn Jeffries, F R.S , and Dr. Wyville Thomson, F.R.S. By C. WYVILLE THOMSON, F.R.S., &c., Director of the Civilian Scientific Staff of the *Challenger* Expedition. Illustrated by 8 Maps and Plates and nearly 100 Woodcuts.

"The book is full of interesting matter, and is written by a master of the art of popular exposition. It is excellently illustrated, both coloured maps and woodcuts possessing high merit. Those who have already become interested in the dredging operations will, of course, make a point of reading this work; those who wish to be pleasantly introduced to the subject, and rightly to appreciate the news which arrives from time to time from the *Challenger*, should not fail to seek instruction from Prof. Thomson."—*Athenæum.*

Second Edition, royal 8vo, cloth extra, 31s. 6d.

The FORCES of NATURE: a Popular Introduction to the Study of Physical Phenomena. By AMEDEE GUILLEMIN. Translated from the French by MRS. NORMAN LOCKYER, and Edited, with Additions and Notes, by J. NORMAN LOCKYER, F.R.S. Illustrated by 11 Coloured Plates and 455 Woodcuts.

"Translator and editor have done justice to their trust. The text has all the force and flow of original writing, combining faithfulness to the author's meaning with purity and independence in regard to idiom, while the technical precision and accuracy pervading the work throughout speak of the watchful editorial supervision which has been given to every scientific detail. Altogether, the work may be said to have no parallel, either in point of fulness or attraction, as a popular manual of physical science."—*Saturday Review.*

Third Edition, royal 8vo, cloth extra, 21s.

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S. With Appendices, Engravings, Maps, and Chromolithographs.

"The Illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations."—*Saturday Review.*

"The lectures themselves furnish a most admirable elementary [illegible] on the subject, whilst by the insertion in [illegible] of extracts from the most important [illegible] dered it equally valuable as a [illegible] *ster Review.*

CALIBA[illegible]

DAN[illegible]

tur[illegible]

SCOTTISH PROVIDENT INSTITUTION,

EDINBURGH: 6, St. Andrew Square. LONDON: 18, King William Street, E.C.

ITS ADVANTAGES over other offices are:—

A larger immediate assurance for the same premium, with the prospect to good lives of eventually receiving very considerable additions.

Thus £1,200 or £1,250 may be secured at once for the premium usually charged for £1,000 only; and policies originally for, say, £1,000, have been increased to £1,400, £1,600, or even to £1,800.

FINANCIAL POSITION.

The Fund, accumulated entirely from the premiums, exceeds £2,250,000. Notwithstanding its low rates, no Office of the same age (Established 1837) has so large a Fund, or shows so large an increase from year to year.

NOTICE.

There will be PUBLISHED, in '*NATURE* for JUNE 4, a NOTICE of the Eminent Naturalist,

CHARLES DARWIN, F.R.S.

By DR. ASA GRAY, With a PORTRAIT beautifully ENGRAVED ON STEEL, by CHARLES H. JEENS,

Forming the THIRD of the SERIES of ILLUSTRATED ARTICLES on

"SCIENTIFIC WORTHIES."

The Publishers would urge upon all regular Subscribers and Readers of NATURE to bring this Announcement under the notice of their Scientific Friends, and those who are Members of Scientific Societies, before their co-Members.

As the printing of the Portrait requires considerable time, it is requested that Orders for Extra Copies be given at the earliest possible moment.

Just ready, Cheap Edition, 18mo, 1s.

The CHILDHOOD of the WORLD: a Simple Account of Man in Early Times. By EDWARD CLODD, F.R.A.S.

"This genial little volume is a child's book as to shortness, cheapness, and simplicity of style, though the author reasonably hopes that older people will use it as a source of information not popularly accessible elsewhere as to the life of Primitive Man and its relation to our own. . . . This book, if the time has come for the public to take to it, will have a certain effect in the world. It is not a mere compilation from the authors mentioned in the preface, but takes its own ground and stands by itself and for itself. Mr. Clodd has thought out his philosophy of life, and used his best skill to bring it into the range of a child's view."—E. B. TYLOR, F.R.S., in NATURE.

"I read your little book with great pleasure. I have no doubt it will do good, and hope you will continue your work. Nothing spoils our temper so much as having to unlearn in youth, manhood, and even old age, so many things which we were taught as children. A book like yours will prepare a far better soil in the child's mind, and I was delighted to have it to read to my children."—Letter from Professor MAX MÜLLER to the Author.

MACMILLAN & CO., London.

Eighth Thousand, cloth, 21s., 70 Plates, 4 Coloured.

HOW TO WORK WITH THE MICROSCOPE. A complete Manual of Microscopical Manipulation. A full description of many new processes of investigation, taking photographs, &c.

HARRISON, Pall Mall.

BY DR. LIONEL BEALE, F.R.S.

1. **PROTOPLASM.—I. Dissentient. II. Demonstrative. III. Speculative.** 3rd Edition, 16 Coloured Plates, 10s. 6d. [*Now ready.*

2. **BIOPLASM, or Living Matter. 22 Plates.** 6s. 6d.

London: J. & A. CHURCHILL.
Philadelphia: LINDSAY & BLAKISTON.

On the 15th of May was published, Seventh Edition, revised throughout, 12mo cloth, 10s. 6d.

MANUAL of BRITISH BOTANY; containing the Flowering Plants and Ferns, arranged according to their Natural Orders. By C. C. BABINGTON, M.A., F.R.S., F.L.S., Professor of Botany in the University of Cambridge.

JOHN VAN VOORST, 1, Paternoster Row.

NEW WORK BY RICHARD A. PROCTOR, B.A.

Just published, in 8vo, illustrated by 22 Lithographic Charts (4 coloured) and 22 Woodcut Diagrams, price 16s.

THE UNIVERSE AND THE COMING

ting Researches into and New Views respecting

together with an Investigation of the

f Venus By R. A. PROCTOR,

London.

nomical treatises."—

ders; its style

pectations

DAVID HUME'S PHILOSOPHICAL WORKS.

On Saturday, the 23rd instant, in 2 vols. 8vo, price 28s.

A TREATISE on HUMAN NATURE, being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects; and Dialogues concerning Natural Religion. By DAVID HUME. Edited, with Preliminary Dissertations and Notes, by T. H. GREEN, M.A., Fellow and Tutor, Ball. Coll. Oxford, and the Rev. T. H. GROSE, M.A. Fellow and Tutor, Queen's Coll. Oxford.

In the Autumn, in 2 vols. 8vo, uniform,

HUME'S ESSAYS, MORAL, POLITICAL, and LITERARY, with Notes, &c., by the same Editors.

⁂ These four volumes will form a New and Complete Edition of DAVID HUME'S "Philosophical Works," to be had in Two separate Sections, as above announced.

London: LONGMANS, GREEN, & CO., Paternoster Row.

Just published, in post 8vo cloth, price 5s.

DIVINE REVELATION or PSEUDO-SCIENCE? An Essay. By R. G. SUCKLING-BROWNE, B.D., Author of "The Mosaic Cosmogony, a Literal Translation of the First Chapter of Genesis, with Annotations and Rationale."

London: LONGMANS, GREEN, & CO., Paternoster Row.

Now ready, small demy 8vo, price 6s.

A TALE of AGES. Being a Description of some of the Geological and Historical Changes which have occurred in the Neighbourhood of Edinburgh. By RALPH RICHARDSON, Secretary Edinburgh Geological Society.

EDMONSTON & DOUGLAS, Edinburgh. HAMILTON, ADAMS, & CO., London.

In royal 8vo, cloth extra gilt, price 31s. 6d.

CONTRIBUTIONS to SOLAR PHYSICS. By J. NORMAN LOCKYER, F.R.S. I. A Popular Account of Inquiries into the Physical Constitution of the Sun, with especial reference to Recent Spectroscopic Researches. II. Communications to the Royal Society of London and the French Academy of Sciences, with Notes. Illustrated by 7 Coloured Lithographic Plates and 175 Woodcuts.

"The first part of the work, presenting the reader with a continuous sketch of the history of the various inquiries into the physical constitution of the sun, cannot fail to be of interest to all who care for the revelations of modern science; and the interest will be enhanced by the excellence of the numerous illustrations by which it is accompanied."—*Athenæum.*

"The book may be taken as an authentic exposition of the present state of science in connexion with the important subject of spectroscopic analysis . . . Even the unscientific public may derive much information from it."—*Daily News.*

London: MACMILLAN & CO.

DIARY OF SOCIETIES.

London

THURSDAY, May 21.

Royal Society, at 8.30.—On the Structure and Development of *Peripatus capensis*: H N Moseley (H M.S *Challenger*) —On the Uniform Wave of Oscillation: J. Imray —Some further Experiments on the Transmission of Sound: Dr Tyndall, F.R S.—On Combinations of Colour by means of Polarised Light W Spottiswoode, Treas R.S
Chemical Society, at 8.—The Sewage Question from a Chemical point of view: W. N. Corfield.
Royal Institution, at 3.—Crystals: N S Maskelyne.

FRIDAY, May 22.

Royal Institution, at 9.—Education of the People: Prof. W. K. Clifford.
Junior Philosophical Society, at 8.—The Superstitions of Great Britain: O. S. Bartlett.
Quekett Microscopical Club, at 8 —On a new Instrument for cutting Sections, both of Hard and Soft Substances for the Microscope: Dr. Hoggan

SATURDAY, May 23.

Royal Institution, at 3.—The Planetary System: R. A. Proctor.

MONDAY, May 25.

Linnean Society, at 3.—Anniversary.
Society of Arts, at 8 —Cantor Lecture; On Carbon and Certain Compounds of Carbon: Prof. Barth
Geologists' Association.—Excursion into Northamptonshire

TUESDAY, May 26

Horticultural Society, at 2.—Meeting of Council.
Anthropological Institute, at 8.—Note on the Discovery of Stone Implements in Egypt; Sir John Lubbock, Bart, F.R S —Researches in Pre-historic and Proto-historic Comparative Philology, Mythology, and Archæology, in connection with the origin of Culture in America, and its propagation by the Sumerian or Akkad Races: Hyde Clarke.
Royal Institution, at 3 —Theory of Musical Instruments with Musical Illustrations: Dr. W. H Stone.

WEDNESDAY, May 27.

Geological Society, at 8
Horticultural Society.—Fruit and Floral Meeting.
Royal Society of Literature, at 8

Maidstone

TUESDAY, May 26.

Maidstone and Mid-Kent Natural History and Philosophical Society, at 8 30 —On Edible and Poisonous Fungi. John H Martin

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in Nature of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of Nature *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

Office—29, BEDFORD STREET, STRAND.

SHELLS, MINERALS, CABINETS, BOOKS, &c.

Mr. J. C. STEVENS will SELL by AUCTION, at his great Rooms, 38, King-street, Covent Garden, on Friday, May 29, at half-past 12 precisely, the Collection of Shells formed by the late Rev. S C. E. Neville Rolfe, of Heacham Hall; also the Cabinets, Books (including Reeve's "Conchologia Iconica"), &c. A small Collection of Minerals and Fossils, Native War Implements.

On view the morning of sale, and catalogues had.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern, packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 . 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5	5	0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water

JUDSON'S DYES.—For Colouring Architectural Plans, &c —Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record *Light* Brown for mahogany colour is excellent; No. 2 Black for walnut, Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

TRADE MARK.

Is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly,

Price of a Single Truss, 16*s.*, 21*s.*, 26*s.* 6*d.*, and 31*s.* 6*d.*
,, Double ,, 31*s.* 6*d.*, 42*s.*, and 52*s.* 6*d.*
,, Umbilical ,, 42*s* and 52*s.* 6*d.*
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c, for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s* 6*d.*, 7*s.* 6*d.*, 10*s.*, and 16*s.* each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

WORKS IN PHYSICAL SCIENCE.

Airy (G. B.)—POPULAR ASTRONOMY. With Illustrations by Sir G. B. AIRY, K.C.B., Astronomer-Royal. Seventh and cheaper edition. 18mo. cloth. 4*s.* 6*d.*

This work consists of Six Lectures, which are intended "to explain to intelligent persons the principles on which the instruments of an Observatory are constructed (omitting all details, so far as they are merely subsidiary), and the principles on which the observations made with these intruments are treated for deduction of the distances and weights of the bodies of the Solar System, and of a few stars, omitting all minutiæ of formulæ, and all troublesome details of calculation." The speciality of this volume is the direct reference of every step to the Observatory, and the full description of the methods and instruments of observation.

Bastian.—Works by H. CHARLTON BASTIAN, M.D., F.R.S., Professor of Pathological Anatomy in University College, London, &c. :—

THE MODES OF ORIGIN OF LOWEST ORGANISMS: Including a Discussion of the Experiments of M. Pasteur, and a Reply to some Statements by Professors Huxley and Tyndall. Crown 8vo. 4*s.* 6*d.*

"It is a work worthy of the highest respect, and places its author in the very first-class of scientific physicians. . . . It would be difficult to name an instance in which skill, knowledge, perseverance, and great reasoning power have been more happily applied to the investigation of a complex biological problem."—*British Medical Journal.*

THE BEGINNINGS OF LIFE: Being some Account of the Nature, Modes of Origin, and Transformations of Lower Organisms. In Two Volumes. With upwards of 100 Illustrations. Crown 8vo. 28*s.*

These volumes contain the results of several years' investigation on the Origin of Life, and it was only after the author had proceeded some length with his observations and experiments that he was compelled to change the opinions he started with for those announced in the present work—the most important of which is that in favour of "spontaneous generation"—the theory that life has never ceased to be actually originated. The first part of the work is intended to show the general reader, more especially, that the logical consequences of the now commonly accepted doctrines concerning the "Conservation of Energy," and the "Correlation of the Vital and Physical Forces" are wholly favourable to the possibility of the independent origin of "living matter." It also contains a view of the "Cellular Theory of Organisation." In the Second Part of the work, under the head "Archebiosis," the question as to the present occurrence or non-occurrence of "spontaneous generation" is fully considered. "He has made a notable contribution to the literature of scientific research and exposition."—*Daily News.* "It is a book that cannot be ignored, and must inevitably lead to renewed discussions and repeated observations, and through these to the establishment of truth."—A. R. WALLACE in NATURE.

Birks (T. R.) On MATTER and ETHER; or, the Secret Laws of Physical Change. By THOMAS RAWSON BIRKS, M.A., Professor of Moral Philosophy in the University of Cambridge. Crown 8vo. 5*s.* 6*d.*

The author believes that the hypothesis of the existence of, besides matter, a luminous ether, of immense elastic force, supplies the true and sufficient key to the remaining secrets of inorganic matter, of the phenomena of light, electricity, &c. In this treatise the author endeavours first to form a clear and definite conception with regard to the real nature both of matter and ether, and the laws of mutual action which must be supposed to exist between them. He then endeavours to trace out the main consequences of the fundamental hypothesis, and their correspondence with the known phenomena of physical change.

Blanford (W. T.)—GEOLOGY and ZOOLOGY of ABYSSINIA. By W. T. BLANFORD. 8vo. 21*s.*

This work contains an account of the Geological and Zoological Observations made by the author in Abyssinia, when accompanying the British Army on its march to Magdala and back in 1868, and during a short journey in Northern Abyssinia, after the departure of the troops. Part I. Personal Narrative; Part II. Geology; Part III. Zoology. With Coloured Illustrations and Geological Map. "The results of his labours," the *Academy* says, "is an important contribution to the natural history of the country."

Cooke (Josiah P., jun.)—FIRST PRINCIPLES of CHEMICAL PHILOSOPHY. By JOSIAH P. COOKE, jun., Ervine Professor of Chemistry and Mineralogy in Harvard College. Crown 8vo. 12*s.* Third Edition, revised and corrected.

The object of the author in this book is to present the philosophy of Chemistry in such a form that it can be made with profit the subject of College recitations, and furnish the teacher with the means of testing the student's faithfulness and ability. With this view the subject has been developed in a logical order, and the principles of the science are taught independently of the experimental evidence on which they rest.

Cooke (M. C.)—HANDBOOK of BRITISH FUNGI, with full descriptions of all the Species, and Illustrations of the Genera. By M. C. COOKE, M.A. Two vols. crown 8vo. 24*s.*

During the thirty-five years that have elapsed since the appearance of the last complete Mycologic Flora no attempt has been made to revise it, to incorporate species since discovered, and to bring it up to the standard of modern science. No apology, therefore, is necessary for the present effort, since all will admit that the want of such a manual has long been felt, and this work makes its appearance under the advantage that it seeks to occupy a place which has long been vacant. No effort has been spared to make the work worthy of confidence, and, by the publication of an occasional supplement, it is hoped to maintain it for many years as *the* "Handbook" for every student of British Fungi. Appended is a complete alphabetical Index of all the divisions and subdivisions of the Fungi noticed in the text. The book contains 400 figures. "Will maintain its place as the standard English book, on the subject of which it treats, for many years to come."—*Standard.*

Dawson (J. W.)—ACADIAN GEOLOGY. The Geologic Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island. By JOHN WILLIAM DAWSON, M.A. LL.D., F.R.S., F.G.S., Principal and Vice-Chancellor of M'Gill College and University, Montreal, &c. Second Edition, revised and enlarged. With a Geological Map and numerous Illustrations. 8vo. 18*s.*

The object of the first edition of this work was to place within reach of the people of the districts to which it relates, a popular account of the more recent discoveries in the geology and mineral resources of their country, and at the same time to give to geologists in other countries a connected view of the structure of a very interesting portion of the American Continent, in its relation to general and theoretical Geology. In the present edition, it is hoped this design is still more completely fulfilled, with reference to the present more advanced condition of knowledge. The author has endeavoured to convey a knowledge of the structure and fossils of the region in such a manner as to be intelligible to ordinary readers, and has devoted much attention to all questions relating to the nature and present or prospective value of deposits of useful minerals. Besides a large coloured Geological Map of the district, the work is illustrated by upwards of 260 cuts of sections, fossils, animals, &c. "The book will doubtless find a place in the library, not only of the scientific geologist, but also of all who are desirous of the industrial progress and commercial prosperity of the Acadian provinces."—*Mining Journal.* "A style at once popular and scientific. . . . A valuable addition to our store of geological knowledge."—*Guardian.*

MACMILLAN AND CO., London.

This day, in 8vo, price 7*s.* 6*d.*

THEORY of the GLACIERS of SAVOY.

BY M. LE CHANOINE RENDU,

TRANSLATED BY ALFRED WILLS, Q.C.

LATE PRESIDENT OF THE ALPINE CLUB.

TO WHICH ARE ADDED THE ORIGINAL MEMOIR, AND SUPPLEMENTARY ARTICLES BY

PROFESSOR TAIT and JOHN RUSKIN, D.C.L.,

EDITED, WITH INTRODUCTORY REMARKS, BY

GEORGE FORBES, B.A.,

Professor of Natural Philosophy in the Andersonian University, Glasgow.

In 8vo, price 16*s.*

THE LIFE AND LETTERS OF JAMES DAVID FORBES, F.R.S.,

LATE PRINCIPAL OF THE UNITED COLLEGE IN THE UNIVERSITY OF ST. ANDREWS.

BY JOHN CAMPBELL SHAIRP, LL.D.

PRINCIPAL OF THE UNITED COLLEGE IN THE UNIVERSITY OF ST. ANDREWS;

PETER GUTHRIE TAIT, M.A.

PROFESSOR OF NATURAL PHILOSOPHY IN THE UNIVERSITY OF EDINBURGH;

AND

A. ADAMS-REILLY, F.R.G.S.

With Portraits, Maps, and Illustrations.

"It has seldom been our good fortune to peruse a biography so entirely satisfactory as that contained in the present volume. There were a wonderful simplicity and unity in the character and career of Principal Forbes, and in this delightful memoir the living man is so faithfully represented, that those who had only known him as the indefatigable physicist, the demonstrator, if not the actual discoverer of the phenomena of glacier structure and motion, or those whom his career never reached, will here find themselves introduced to a personal acquaintance; while his many friends and loyal students will gratefully acknowledge that Prof. Shairp and his able coadjutors have done their work wisely and well. At once a graceful literary monument to the memory of a good man, and an exhaustive scientific manual on the special subjects to which Forbes's life was consecrated."—*Spectator.*

MACMILLAN AND CO., London.

Now Ready. Price One Shilling.

A R T

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR MAY 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF MAY NUMBER—Our Illustrations:—1. "The Beheading of St. John," by Puvis de Chavannes. 2. "Lady Sitting Before an Easel Picture," by M. Corot. 3. "After the Bath," by Corot. "The Age of Innocence," by Samuel Cousins, R.A., after Sir Joshua Reynolds.—The Exhibitions: The Society of Painters in Water Colours, the Institute of Painters in Water Colours, the Society of French Artists, New Bond Street.—Art Notes and Gossip.—Review.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

VICHY WATERS COMPANY,

27, MARGARET STREET, REGENT STREET, LONDON, W.

DEPOT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

Just Published. 8vo. Price 14*s*.

A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS;

OR, ORGANIC CHEMISTRY.

By C. SCHORLEMMER, F.R.S.,

LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.

London: MACMILLAN AND CO.

PERUVIAN GOVERNMENT GUANO.

MESSRS. J. HENRY SCHRODER & CO.,

OF EAST INDIA AVENUE, AND 15, LEADENHALL STREET, LONDON,

Hereby Give NOTICE that they are now the SOLE CONSIGNEES of this GUANO in the United Kingdom.

The price is 13*l*. per ton, for lots of not less than 30 tons, or 14*l*. 5*s*. per ton for any smaller quantity.

Prompt cash, per ton in bags, gross weight at any of their depôts.

Further particulars may be ascertained on application to them or to their Agents—

Messrs. J. H. SCHRODER & CO., 13, Rumford Place, Liverpool;
Messrs. WM. SMITH & CO., 10, Corn Street, Bristol, and at King's Lynn;
Messrs. EDWARDS, WINKLEY, & CO., 160, High Street, Hull;
Mr. J. CAMERON SWAN, 1, Dean Street, Newcastle-on-Tyne.

DISSOLVED PERUVIAN GUANO,

PREPARED BY

OHLENDORFF & CO.

LONDON, ANTWERP, HAMBURGH, AND EMMERICH-ON-RHINE.

GUARANTEED TO CONTAIN

Nitrogen equal to 10 per cent. of non-volatile Ammonia.
20 " soluble } Guano Phosphates.
4 " insoluble } Guano Phosphates.
Price:—14*l*. per ton for 30 tons and upwards.
15*l*. " lots under 30 tons.

Delivered free at any of their depôts in the United Kingdom
AGAINST CASH.

This Manure is prepared from GENUINE PERUVIAN GOVERNMENT GUANO. The result of its special treatment is, that the ammonia is FIXED, the phosphates in the raw Guano rendered SOLUBLE and the Manure brought into the condition of a free dry powder.

It loses nothing from exposure to the atmosphere, or to the heat of the sun. It is offered to the Farmer with a Guarantee of its composition, and is, in fact, the richest, and, considering the quality, the cheapest GUARANTEED Manure at present in the market. Its fertilising properties are such as will enable the consumer to derive the greatest economical advantage from the use of Guano.

OHLENDORFF & CO.

OFFICES:—110, Fenchurch Street, London, E.C.
WORKS:—At Plaistow, near Victoria Docks.
DEPOTS:—In London, at the above Works, and at the principal Outports.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, May 21, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 239, VOL. 10] THURSDAY, MAY 28, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

LONDON INTERNATIONAL EXHIBITION

AND ROYAL ALBERT HALL, SOUTH KENSINGTON, 1874.

OPEN DAILY, 10 a m to 6 p.m.

MILITARY BAND

At Three every THURSDAY and SATURDAY.

PERFORMANCE on the GRAND ORGAN

By Mr. WILLIAM CARTER, DAILY at 4.

EXHIBITION OF WINE

(Tasting permitted)

OPEN DAILY, Twelve to Five, Season Ticket holders admitted WITHOUT EXTRA CHARGE. Other Visitors will be charged 6d extra to the Cellars

TECHNICAL INSTRUCTION.

Packets of FIFTY TICKETS may be purchased for Schools at 3d each Ticket, and for Artisans at 6d each Ticket, admissible to the INTERNATIONAL EXHIBITION and ROYAL ALBERT HALL EVERY DAY except WEDNESDAY, from Ten to Six.

SCHOOL OF COOKERY.

LECTURE (with Practical Illustrations) by Mr. BUCKMASTER, every SATURDAY at Three.

GRAND OPERA CONCERT

On SATURDAY, June 6, at Three.

ADMISSION to the EXHIBITION and ALBERT HALL, 1s. Daily (Wednesdays, 2s 6d)

UNIVERSITY COLLEGE, TORONTO.—Applications will be received up to August 15th from Candidates for the PROFESSORSHIP of NATURAL HISTORY in this College. The initial salary is £550 currency per annum, rising to £700 currency by additions of £50 currency at intervals of five years The applications, with testimonials (originals or certified copies) are to be addressed to the Hon ARCHIBALD MCKELLAR, Provincial Secretary, Toronto, Ontario, in envelopes marked "Natural History," and should be posted so as to reach him on or before August 15

The Academic Year of the College will begin on October 1st, and Lectures will begin on October 5th

JOHN McCAUL, LL.D , President

University College, Toronto, May 2nd, 1874

SCIENTIFIC BOOKS.—A few copies can still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Conchiliorum, Tankerville Cat , &c , &c , as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c. &c. SOWERBY, 167A, Strand.

UNIVERSITY OF LONDON.

NOTICE is Hereby Given, that the next Half-yearly Examination for MATRICULATION in this University will commence on MONDAY, the 29th of June, 1874. In addition to the Metropolitan Examination, Provincial Examinations will be held at St. Cuthbert's College, Ushaw , Stonyhurst College ; Owens College, Manchester , Queen's College, Liverpool and Queen's College, Birmingham.

Every Candidate is required to transmit his Certificate of Age to the Registrar (University of London, Burlington Gardens, London, W) at least fourteen days before the commencement of the Examination.

Candidates who pass the Matriculation Examination are entitled to proceed to the Degrees conferred by the University in Arts, Laws, Science, and Medicine. This Examination is accepted (1) by the Council of Military Education in lieu of the Entrance Examination otherwise imposed on Candidates for admission to the Royal Military College at Sandhurst , and (2) by the College of Surgeons in lieu of the Preliminary Examination otherwise imposed on Candidates for its Fellowship. It is also among those Examinations of which some one must be passed (1) by every Medical Student on commencing his professional studies ; and (2) by every person entering upon Articles of Clerkship to an Attorney—any such person matriculating in the First Division being entitled to exemption from one year's service.

WILLIAM B. CARPENTER, M D.

Registrar

May 26, 1874

PRELIMINARY EXAM. IN ARTS, COLL SURG., June 1874.

MR. HANBURY, M.A., Wrangler and late Senior Scholar of his College, will shortly begin to read with Classes for this Examination. Mr Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has passed several Pupils for this Examination, to whom references are allowed. An early Class will commence towards the latter part of February, and a later one about Lady Day. Fee for the Course, from 7 to 12 guineas, according to the time of commencement and number of subjects taken up —Address, 24 Old Square, Lincoln's Inn, W.C.

MATRICULATION EXAMINATION, LOND. UNIV., June 1874

MR. HANBURY, M.A., Wrangler and late Senior Scholar of his College, reads with Pupils for this Examination Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Examination, having passed fifty-three Pupils, to whom references can be given. An early class about Lady-day, and a later one will commence the middle of February Fees for the two, 14l and 10l 10s respectively For further particulars, address to 24, Old Square, Lincoln's-inn, W C Two of Mr Hanbury's pupils passed the Matriculation Examination in January 1873, in the Honours list, seventh and fourteenth respectively

A few Residents can be accommodated in Mr. Hanbury's house, at Clapham.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and Investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

TO NATURALISTS and GEOLOGISTS. In the River Marshes near the picturesque ruin of Orford Castle, Suffolk, a lately made cutting in the Crag formation is bringing to light numerous Fossils, including some of the rarer species in a high state of preservation, and arrangements are now being made by means of a small Subscription from Naturalists who may wish to possess sets of these Fossils to secure as many of them as possible while the cutting is open. The collecting operation, and the labelling the Fossils will be done under the direction of Mr. Charlesworth, while details can be had by written application (with stamped envelope) to Fredc. Collingwood, Esq., F.G.S., 4, St. Martin's Place, Trafalgar Square, W.C.

NOTICE.—To Science Classes.—MOTTERSHEAD & CO., Laboratory Furnishers, Exchange Street, Manchester, supply all the Apparatus enumerated in the South Kensington Lists for the use of Teachers of Physical Science (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

NATURAL SCIENCE MASTERSHIP WANTED after July 31 next by a Graduate of Cambridge, in a first-rate Grammar School. The highest testimonials.—Address, M.A., care of NATURE, 29, Bedford Street, Covent Garden, London, W.C.

A YOUNG LADY seeks a RE-ENGAGEMENT as GOVERNESS in London. She is capable of teaching the rudiments of NATURAL SCIENCE, and has a thorough knowledge of French, German, and the usual branches of a sound English Education.—Address, Miss K., NATURE Office, 29, Bedford Street, Strand, W.C.

REQUIRED, a MATHEMATICAL and NATURAL SCIENCE MASTERSHIP in a good School, by a CAMBRIDGE HONOUR-MAN.—Address—Alpha, care of the Publishers of NATURE, 29, Bedford Street, Strand, W.C.

A D.Sc. (Lond.), Master in a Public School, proposing to spend some weeks in Germany, would undertake the charge of Pupils.—For Terms, &c., address D.Sc., NATURE Office.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS. Must all be well authenticated.—Apply, stating terms, to E. E. B., care of Messrs. MACMILLAN and Co., Bedford Street, Strand, W.C.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X.Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

NATURE.—Wanted clean Copies of Nos. 10, 12, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 „	One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

JAMES WOOLLEY, SONS, & CO.,
69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,
For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS
For the various Public Examinations.

Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

HENRY CROUCH'S
NEW CATALOGUE OF
MICROSCOPES, OBJECTIVES, &c.
With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,
Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly,

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
„ Double „ 31s. 6d., 42s., and 52s. 6d.
„ Umbilical „ 42s. and 52s. 6d.
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

Now ready,

NEGRETTI & ZAMBRA'S
NEW ENCYCLOPÆDIC CATALOGUE
Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard
METEOROLOGICAL INSTRUMENTS,
Containing very numerous Comparative Tables of Reference, and illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s. 6d.

NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,
HOLBORN VIADUCT,
45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever And superior to all others *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867 Also Testimonials from Dr Hassall, September 23, 1863, Dr Lankester, September 30, 1867; Dr Letheby, February 15, 1865, and December 1872.

Price £1 10s. and upwards Portable Filters on this system, £1 5s to £3

Patronised and used by Her Majesty the Queen, at Osborne, by H.R H. the Prince of Wales, at Sandringham; by H R.H the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s. each

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers

Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,

157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2d.

Now ready, price 20s.

JOURNAL OF THE ROYAL GEOGRAPHICAL SOCIETY.

Vol. XLIII.

Edited by W. H. BATES, F L.S., Assistant-Secretary.

CONTENTS.

1. On the Garo Hills. By Major H. H Godwin-Austen, R.E.
2. On a Projected Railway Route over the Andes. By R. Crawford, C.E. (Map.)
3. Journey from Kióto to Yedo. By C. W. Lawrence (Map.)
4. Journey from Bandar Abbas to Mash-had, by Sistan, with some Account of the last-named Province. By Major-Gen. Sir F. J. Goldsmid, K.C.S I. (Map)
5. On Discoveries East of Spitzbergen, and Approaches towards the North Pole on the Spitzbergen Meridian. By C. R. Markham, C.B. F R S. (Map.)
6. Notes of a Journey in Southern Formosa By J. Thomson. (Map.)
7. Narrative of a Journey through Western Mongolia. By Ney Elias, jun. (Map)
8. The Site of the Lost Colony of Greenland Determined, and Pre-Columbian Discoveries of America Confirmed from Fourteenth-Century Documents. By R. H. Major, F.S A. (Four Maps)
9. Recent Surveys in Sinai and Palestine. By Major C. W. Wilson, R.E. (Map.)
10. Recent Elevations of the Earth's Surface in the Northern Circumpolar Regions. By Henry Howorth.
11. Notes on M. Fedchenko's Map of Maghian. By R. Michell (Map)
12. Notes on Seistán. By Major-Gen. Sir H. C. Rawlinson, K.C.B. (Map)
13. Report on the Country Around Aden. By Captain G. J. Stevens. (Map)

⁂ Fellows are requested to apply for their Copies at the Office of the Society, 1, Savile Row, Burlington Gardens, W.

JOHN MURRAY, Albemarle Street.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

HOLLOWAY'S OINTMENT and PILLS.

Hearty and Healthy.—The experience of thousands has amply demonstrated the power possessed by these healing and purifying remedies of removing cutaneous eruptions and relieving fistulas and abscesses These hidden evils frequently rob life of every comfort, through the reluctance of the sufferer to expose his infirmity Holloway's Ointment supersedes such dreadful publicity by placing within reach of all plain instructions for curing themselves, without any danger and without the necessity of mentioning their malady to any one. The most bashful need only send to any chemist for these remedies, read their "directions for use," set forth in clear, precise, pertinent language, and cure their own infirmities

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S, Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co, Stationers' Hall Court.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U S.A.

SCOTTISH PROVIDENT INSTITUTION,

EDINBURGH: 6, St. Andrew Square. LONDON: 18, King William Street, E.C.

ITS ADVANTAGES over other offices are:—

A larger immediate assurance for the same premium, with the prospect to good lives of eventually receiving very considerable additions.

Thus £1,200 or £1,250 may be secured at once for the premium usually charged for £1,000 only; and policies originally for, say, £1,000, have been increased to £1,400, £1,600, or even to £1,800.

FINANCIAL POSITION.

The Fund, accumulated entirely from the premiums, exceeds £2,250,000. Notwithstanding its low rates, no Office of the same age (Established 1837) has so large a Fund, or shows so large an increase from year to year.

NOTICE.

There will be PUBLISHED, in *NATURE* for JUNE 4, a NOTICE of the Eminent Naturalist,

CHARLES DARWIN, F.R.S.

By DR. ASA GRAY, With a PORTRAIT beautifully ENGRAVED ON STEEL, by CHARLES H. JEENS, Forming the THIRD of the SERIES of ILLUSTRATED ARTICLES on

"SCIENTIFIC WORTHIES."

The Publishers would urge upon all regular Subscribers and Readers of NATURE to bring this Announcement under the notice of their Scientific Friends, and those who are Members of Scientific Societies, before their co-Members.

As the printing of the Portrait requires considerable time, it is requested that Orders for Extra Copies be given at the earliest possible moment.

NEW WORK BY RICHARD A. PROCTOR, B.A.

Just published, in 8vo, illustrated by 22 Lithographic Charts (4 coloured) and 22 Woodcut Diagrams, price 16s

THE UNIVERSE AND THE COMING TRANSITS:

Presenting Researches into and New Views respecting the Constitution of the Heavens; together with an Investigation of the Conditions of the approaching Transits of Venus. By R. A. PROCTOR, B.A., Honorary Fellow of King's College, London.

"One of the most exhaustive of modern astronomical treatises."—*Standard.*

"We heartily commend this book to the attention of our readers; its style is plain, but its matter and substance will gratify their utmost expectations of the grand and the sublime."—*Edinburgh Courant.*

London: LONGMANS, GREEN, & CO., Paternoster Row.

Just published, in 8vo, price 1s. 6d.

REPORT upon the SANITARY CONDITION

of the DISTRICTS of the COMBINED SANITARY AUTHORITIES of OXFORDSHIRE, from Lady-day 1871 to Lady-day 1874. By GILBERT W. CHILD, Officer of Health to the above Authorities.

London: LONGMANS, GREEN, & CO., Paternoster Row.

DAVID HUME'S PHILOSOPHICAL WORKS.

Now ready, in 2 vols 8vo, cloth, price 28s.

A TREATISE on HUMAN NATURE,

being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects; and Dialogues concerning Natural Religion. By DAVID HUME. Edited, with Preliminary Dissertations and Notes, by T. H. GREEN, M.A., Fellow and Tutor, Ball. Coll. Oxford, and the Rev. T. H. GROSE, M.A. Fellow and Tutor, Queen's Coll. Oxford.

In the Autumn, in 2 vols. 8vo, uniform,

HUME'S ESSAYS, MORAL, POLITICAL, and LITERARY,

with Notes, &c., by the same Editors.

⁂ These four volumes will form a New and Complete Edition of DAVID HUME'S "Philosophical Works," to be had in Two separate Sections, as above announced

London: LONGMANS, GREEN, & CO., Paternoster Row.

Eighth Thousand, cloth, 21s., 70 Plates, 4 Coloured.

HOW TO WORK WITH THE MICROSCOPE.

A complete Manual of Microscopical Manipulation. A full description of many new processes of investigation, taking photographs, &c.

HARRISON, Pall Mall.

BY DR. LIONEL BEALE, F.R.S.

1. PROTOPLASM.—I. Dissentient. II. Demonstrative. III. Speculative. 3rd Edition, 16 Coloured Plates, 10s 6d. [*Now ready.*
2. BIOPLASM, or Living Matter. 22 Plates. 6s. 6d.

London: J. & A. CHURCHILL.
Philadelphia: LINDSAY & BLAKISTON.

WORKS BY MR. E. B. TYLOR.

Now ready, Second Edition, 2 vols. 8vo, 24s.

PRIMITIVE CULTURE: Researches into

the Development of Mythology, Philosophy, Religion, Language, Art, and Custom. By EDWARD B. TYLOR, LL.D F.R.S.

"Mr. Tylor's work is a monument of enormous reading and conscientiously acquired knowledge. His book is one of a kind of which we hope to have an increasing number—the book of a man trying to know all about his subject that can be known, and more than has been known hitherto."—*Pall Mall Gazette.*

By the same Author.

RESEARCHES into the EARLY HISTORY of MANKIND,

and the Development of Civilisation. Second Edition. 8vo, 12s.

"This volume is the most important contribution to the history of civilisation and of the human race which we have received for many years past It is a book of remarkable ability, and which betrays in every page the traces of unwearied research."—*English Churchman.*

"It would be impossible to give any idea of the interesting series of facts brought together in an eminently suggestive manner in this valuable book."—*Westminster Review.*

JOHN MURRAY, Albemarle Street.

In royal 8vo, cloth extra gilt, price 31s. 6d.

CONTRIBUTIONS to SOLAR PHYSICS.

By J. NORMAN LOCKYER, F.R.S. I. A Popular Account of Inquiries into the Physical Constitution of the Sun, with especial reference to Recent Spectroscopic Researches. II. Communications to the Royal Society of London and the French Academy of Sciences, with Notes. Illustrated by 7 Coloured Lithographic Plates and 175 Woodcuts.

"The first part of the work, presenting the reader with a continuous sketch of the history of the various inquiries into the physical constitution of the sun, cannot fail to be of interest to all who care for the revelations of modern science; and the interest will be enhanced by the excellence of the numerous illustrations by which it is accompanied"—*Athenæum.*

"The book may be taken as an authentic exposition of the present state of science in connexion with the important subject of spectroscopic analyses. . . . Even the unscientific public may derive much information from it."—*Daily News.*

London: MACMILLAN & CO.

Now ready, small demy 8vo, price 6s.

A TALE of AGES. Being a Description

of some of the Geological and Historical Changes which have occurred in the Neighbourhood of Edinburgh. By RALPH RICHARDSON, Secretary Edinburgh Geological Society.

EDMONSTON & DOUGLAS, Edinburgh. HAMILTON, ADAMS, & CO., London

DIARY OF SOCIETIES.

LONDON

THURSDAY, MAY 28.

ROYAL INSTITUTION, at 3.—Crystals: N S. Maskelyne.

FRIDAY, MAY 29.

ROYAL INSTITUTION, at 9—The Roman Catacombs: Dean Stanley.
GRESHAM LECTURES, at 7—Digestion and Indigestion: Dr. E. S Thompson.

SATURDAY, MAY 30.

ROYAL INSTITUTION, at 3—The Planetary System: R. A. Proctor.
GRESHAM LECTURES, at 7.—Magnetism: Dr. E. S. Thompson.

MONDAY, JUNE 1.

ROYAL INSTITUTION, at 2—General Monthly Meeting.
GEOGRAPHICAL SOCIETY, at 1.—Anniversary.

TUESDAY, JUNE 2.

ZOOLOGICAL SOCIETY, at 8 30—On the Osteology of the Marsupialia; Part V: Prof. Owen—Descriptiones Annulatorum novorum mare Ceylonicum habitantium ab honoratissimo Holdsworth collectorum Dr. E Grube—On the nature of the Sacs vomited by the Hornbills: Dr. J. Murie.
HORTICULTURAL SOCIETY, at 2—Meeting of Council.
ROYAL INSTITUTION, at 3—Musical Instruments: Dr. W. H. Stone

WEDNESDAY, JUNE 3.

MICROSCOPICAL SOCIETY, at 8.

THURSDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—Crystals: N. S. Maskelyne.
HORTICULTURAL SOCIETY.—Great Summer Show.
CHEMICAL SOCIETY, at 8.—On Dendritic Spots. H Adrien—On the Acidity of Normal Urine: J Reoch.—On certain compounds of Albumen with Acids: G S Johnson—On a simple form of Apparatus for estimating Urea in Urine. Dr. W. J Russel and S. H. West.—On Ipomœic Acid: E. Neison and J Bayne—On the Action of Chlorine and Bromine on Iso-dinaphthyl. W. Smith.—On Acetyl Sulphite and On a new formation of Toluol: Dr D Tommasi

MANCHESTER

TUESDAY, JUNE 2.

GEOLOGICAL SOCIETY, at 8 30.—Siliceous Boulders.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

TISLEY'S
PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on … … … … … … … … …	£12 0 0
Reflectors for projecting the Figures on the Screen … …	2 12 6
N.B—Specimen Curves, on card, post free … per dozen…	0 3 0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3…	0 7 6
Ditto traced on blackened Glass, for the Lantern … per slide…	0 3 6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution … £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

NEW ELECTRICAL ANEMOMETER.
NO SHAFT REQUIRED.
INVENTED BY
J. E. H. GORDON, CAIUS COLLEGE, CAMBRIDGE.

Mr. APPS is now prepared to supply these Instruments complete with wires and six-celled battery at the following prices:—

No. I. to indicate direction on an 8-in. dial, £30.

No. II to indicate direction and velocity on dials, £50.

No IV. to indicate direction, and print direction and velocity, £100.

In these instruments the communication between the vane and dial is made by 3 or 4 insulated wires.

The battery has to be recharged once in 5 months (about)

The paper can be cut off as soon as desired, but the reels only require refilling once a in months.

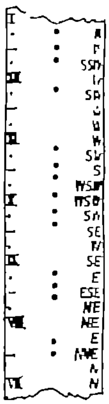
The registering instrument can be placed at any distance from the fans or cups.

The clock of the recording instrument being fitted with a dial, there is no necessity for a timepiece for general purposes.

This instrument is now to be seen at work in connection with the Society of Arts' Testing Rooms, International Exhibition, South Kensington; and a

No IV. Anemometer may now be seen in action at

A. APPS,
433, STRAND, LONDON, W.C.



Specimen of Record Slip. Each dot represents one mile of wind. (About half-size.)

DRAPER'S INK (DICHROIC).
THE NEW BLACK INK
DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens
Is cleanly to use, and not liable to Blot.

Flows easily from the Pen
Blotting-paper may be applied at the moment of writing

TO BE HAD OF ALL STATIONERS.

FRY'S
VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

WORKS IN PHYSICAL SCIENCE.

Flower (W. H.)—An INTRODUCTION to the OSTEOLOGY of the MAMMALIA. Being the substance of the Course of Lectures delivered at the Royal College of Surgeons of England in 1870. By W. H. FLOWER, F.R.S., F.R.C.S., Hunterian Professor of Comparative Anatomy and Physiology. With numerous Illustrations. Globe 8vo, 7*s.* 6*d.*

Although the present work contains the substance of a Course of Lectures the form has been changed, so as the better to adapt it as a handbook for students. Theoretical views have been almost entirely excluded; and while it is impossible in a scientific treatise to avoid the employment of technical terms, it has been the author's endeavour to use no more than absolutely necessary, and to exercise due care in selecting only those that seem most appropriate, or which have received the sanction of general adoption. With a very few exceptions the illustrations have been drawn expressly for this work from specimens in the Museum of the Royal College of Surgeons.

Galton—Works by Francis Galton, F.R.S.—

METEOROGRAPHICA, or Methods of Mapping the Weather. Illustrated by upwards of 600 Printed Lithographic Diagrams. 4to, 9*s.*

As Mr. Galton entertains strong views on the necessity of meteorological charts and maps, he determined, as a practical proof of what could be done, to chart the area of Europe, so far as meteorological stations extend, during one month, viz. the month of December 1861. Mr. Galton got his data from authorities in every part of Britain and the Continent, and on the basis of these has here drawn up nearly a hundred different maps and charts, showing the state of the weather all over Europe during the above period.

HEREDITARY GENIUS: An Inquiry into its Laws and Consequences. Demy 8vo, 12*s.*

"A most able and most interesting book."—*Times.* "We know through the admirable labours of Mr. Galton, that Genius tends to be inherited."—Darwin's "Descent of Man," vol. i. p. 3.

Geikie (A.)—SCENERY of SCOTLAND, Viewed in Connection with its Physical Geography. With Illustrations and a new Geological Map. By ARCHIBALD GEIKIE, Professor of Geology in the University of Edinburgh. Crown 8vo, 10*s.* 6*d.*

"We can confidently recommend Mr. Geikie's work to those who wish to look below the surface and read the physical history of the Scenery of Scotland by the light of modern Science."—*Saturday Review.* "Amusing, instructive, and picturesque."—*Times.*

Guillemin.—The FORCES of NATURE: A Popular Introduction to the Study of Physical Phenomena. By AMEDEE GUILLEMIN. Translated from the French by Mrs. NORMAN LOCKYER; and Edited, with Additions and Notes, by J. NORMAN LOCKYER, F.R.S. Illustrated by 11 Coloured Plates and 455 Woodcuts. Second Edition. Imperial 8vo, cloth, extra gilt, 31*s.* 6*d.*

"Translator and Editor have done justice to their trust. The text has all the force and flow of original writing, combining faithfulness to the author's meaning with purity and independence in regard to idiom; while the historical precision and accuracy pervading the work throughout speak of the watchful editorial supervision which has been given to every scientific detail. Nothing can well exceed the clearness and delicacy of the illustrative woodcuts, borrowed from the French edition, or the purity and chromatic truth of the coloured plates. Altogether the work may be said to have no parallel, either in point of fulness or attraction, as a popular manual of physical science. . . . What we feel, however, bound to say, and what we say with pleasure, is, that among works of its class no publication can stand comparison either in literary completeness or in artistic grace with it."—*Saturday Review.*

Hooker (Dr.)—The STUDENT'S FLORA of the BRITISH ISLANDS. By J. D. HOOKER, C.B. F.R.S. M.D. D.C.L., Director of the Royal Gardens, Kew. Globe 8vo, 10*s.* 6*d.*

The object of this work is to supply students and field-botanists with a fuller account of the Plants of the British Islands than the manuals hitherto in use aim at giving. The ordinal, generic, and specific characters have been re-written, and are to a great extent original, and drawn from living or dried specimens, or both. "Cannot fail to perfectly fulfil the purpose for which it is intended."—*Land and Water.* "Containing the fullest and most accurate manual of the kind that has yet appeared."—*Pall Mall Gazette.*

Huxley (Professor).—LAY SERMONS, AD- DRESSES, and REVIEWS. By T. H. HUXLEY, LL.D. F.R.S. New and Cheaper Edition. Crown 8vo, 7*s.* 6*d.*

Fourteen Discourses on the following subjects:—1. On the Advisableness of Improving Natural Knowledge. 2. Emancipation—Black and White. 3. A Liberal Education, and where to find it. 4. Scientific Education. 5. On the Educational Value of the Natural History Sciences. 6. On the Study of Zoology. 7. On the Physical Basis of Life. 8. The Scientific Aspects of Positivism. 9. On a Piece of Chalk. 10. Geological Contemporaneity and Persistent Types of Life. 11. Geological Reform. 12. The Origin of Species. 13. Criticisms on the "Origin of Species." 14. On Descartes' "Discourse touching the Method of using one's Reason rightly and of seeking Scientific Truth."

LESSONS in ELEMENTARY PHYSIOLOGY. With numerous Illustrations. New Edition. 18mo, cloth, 4*s.* 6*d.*

This book describes and explains, in a series of graduated lessons, the principles of Human Physiology, or the Structure and Functions of the Human Body. The first lesson supplies a general view of the subject. This is followed by sections on the Vascular or Venous System, and the Circulation; the Blood and the Lymph; Respiration; Sources of Loss and of Gain to the Blood; The Functions of Alimentation; Motion and Locomotion; Sensations and Sensory Organs; the Organs of Sight; the Coalescence of Sensations with one another and with other States of Consciousness; the Nervous System and Innervation; Histology, or the Minute Structure of the Tissues. A Table of Anatomical and Physiological Constants is appended. "Unquestionably the clearest and most complete elementary treatise on this subject that we possess in any language."—*Westminster Review.* "Pure gold throughout."—*Guardian.*

Jellet (John H., B.D.)—A TREATISE on the THEORY of FRICTION. By JOHN H. JELLET, B.D., Senior Fellow of Trinity College, Dublin; President of the Royal Irish Academy. 8vo, 8*s.* 6*d.*

This work consists of eight chapters as follows:—I. Definitions and Principles. II. Equilibrium and Frictions. III. Extreme Positions of Equilibrium. IV. Movement of a Particle or System of Particles. V. Motion of a Solid Body. VI. Necessary and Possible Equilibrium. VII. Determination of the Actual Value of the Acting Force of Friction. VIII. Miscellaneous Problems—1. Problems of the Top. 2. Friction Wheels and Locomotives. 3. Questions for Exercise. "The book supplies a want which has hitherto existed in the science of pure mechanics."—*Engineer.*

Jones.—The OWENS COLLEGE JUNIOR COURSE of PRACTICAL CHEMISTRY. By FRANCIS JONES, Chemical Master in the Grammar School, Manchester. With Preface by Professor ROSCOE. 18mo, with Illustrations, 2*s.* 6*d.*

MACMILLAN AND CO., London.

MR. BOWDLER SHARPE'S NEW ORNITHOLOGICAL WORKS WILL BE READY IN A FEW DAYS.

A CATALOGUE of the BIRDS in the BRITISH MUSEUM. Vol. I., containing the "Accipitres or Diurnal Birds of Prey."

This work will give full descriptions of all the species known, with their habitats, keys to the genera and species, &c. It will be illustrated by 14 Coloured Plates and about 60 Woodcuts by Keulemans. The price, it is believed, will be 21s.

In the Press.

A NEW EDITION, thoroughly revised and augmented, of

LAYARD'S BIRDS of SOUTH AFRICA. Illustrated by 12 Coloured Plates Subscription price, £1 11s. 6d.

BERNARD QUARITCH, 15, Piccadilly, London.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

Second Edition, royal 8vo, cloth extra gilt, 31s 6d.

The DEPTHS of the SEA: An Account of the General Results of the Dredging Cruises of H M SS *Porcupine* and *Lightning* during the Summers of 1868-69-70, under the Scientific Direction of Dr Carpenter, F.R S, J. Gwyn Jeffries, F R S, and Dr. Wyville Thomson, F.R.S. By C WYVILLE THOMSON, F.R S, &c, Director of the Civilian Scientific Staff of the *Challenger* Expedition. Illustrated by 8 Maps and Plates and nearly 100 Woodcuts

"The book is full of interesting matter, and is written by a master of the art of popular exposition It is excellently illustrated, both coloured maps and woodcuts possessing high merit. Those who have already become interested in the dredging operations will, of course, make a point of reading this work, those who wish to be pleasantly introduced to the subject, and rightly to appreciate the news which arrives from time to time from the *Challenger*, should not fail to seek instruction from Prof Thomson"—*Athenæum.*

Second Edition, royal 8vo, cloth extra, 31s 6d.

The FORCES of NATURE: a Popular Introduction to the Study of Physical Phenomena. By AMEDEE GUILLEMIN Translated from the French by MRS. NORMAN LOCKYER, and Edited, with Additions and Notes, by J NORMAN LOCKYER, F.R S Illustrated by 11 Coloured Plates and 455 Woodcuts.

"Translator and editor have done justice to their trust. The text has all the force and flow of original writing, combining faithfulness to the author's meaning with purity and independence in regard to idiom; while the technical precision and accuracy pervading the work throughout speak of the watchful editorial supervision which has been given to every scientific detail Altogether, the work may be said to have no parallel, either in point of fulness or attraction, as a popular manual of physical science"—*Saturday Review.*

Third Edition, royal 8vo, cloth extra, 21s

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S. With Appendices, Engravings, Maps, and Chromolithographs

"The illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations"—*Saturday Review.*

"The lectures themselves furnish a most admirable elementary treatise on the subject, whilst by the insertion in appendices to each lecture of extracts from the most important published memoirs, the author has rendered it equally valuable as a text-book for advanced students."—*Westminster Review.*

CALIBAN: The MISSING LINK. By DANIEL WILSON, LL D., Professor of History and English Literature in University College, Toronto. 8vo, 10s. 6d.

MACMILLAN & CO., LONDON.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c, by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water They sink deeply into the fibre, and will not rub off They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country

---

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle —*Athenæum*

"The chart cannot fail to be very useful to the keepers of horses and meat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association"—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading

Price 6d. per month, or 5s. per annum, Post Free.

Vols. I., II, and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7s. 6d each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED FROM AN ACRE OF SOIL by an Average Crop of Wheat, Oats, Barley, Turnips, &c, also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E C, and 47, MILLBANK STREET, S W

This day, in 8vo, price 14s., with Woodcuts

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue

London: MACMILLAN & CO.

E. DENT & CO., 61, Strand, & 34, Royal Exchange.

(FACTORY, SAVOY ST.), LONDON.

MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c., TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.

MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.

MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.

Catalogues or Estimates on Application.

VICHY WATERS COMPANY,

27, MARGARET STREET, REGENT STREET, LONDON, W.

DEPOT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

PERUVIAN GOVERNMENT GUANO.

MESSRS. J. HENRY SCHRODER & CO.,

OF EAST INDIA AVENUE, AND 15, LEADENHALL STREET, LONDON,

Hereby Give NOTICE that they are now the SOLE CONSIGNEES of this GUANO in the United Kingdom.

The price is 13*l.* per ton, for lots of not less than 30 tons, or 14*l.* 5*s.* per ton for any smaller quantity.

Prompt cash, per ton in bags, gross weight at any of their depôts.

Further particulars may be ascertained on application to them or to their Agents—

Messrs. J. H. SCHRODER & CO., 13, Rumford Place, Liverpool;
Messrs. WM. SMITH & CO., 10, Corn Street, Bristol, and at King's Lynn;
Messrs. EDWARDS, WINKLEY, & CO., 160, High Street, Hull;
Mr. J. CAMERON SWAN, 1, Dean Street, Newcastle-on-Tyne.

DISSOLVED PERUVIAN GUANO,

PREPARED BY

OHLENDORFF & CO.

LONDON, ANTWERP, HAMBURGH, AND EMMERICH-ON-RHINE.

GUARANTEED TO CONTAIN

Nitrogen equal to 10 per cent. of non-volatile Ammonia.
20 " soluble } Guano Phosphates.
4 " insoluble }
Price :—14*l.* per ton for 30 tons and upwards.
15*l.* " lots under 30 tons.

Delivered free at any of their depôts in the United Kingdom AGAINST CASH.

This Manure is prepared from GENUINE PERUVIAN GOVERNMENT GUANO. The result of its special treatment is, that the ammonia is FIXED, the phosphates in the raw Guano rendered SOLUBLE and the Manure brought into the condition of a free dry powder.

It loses nothing from exposure to the atmosphere, or to the heat of the sun. It is offered to the Farmer with a Guarantee of its composition, and is, in fact, the richest, and, considering the quality, the cheapest GUARANTEED Manure at present in the market. Its fertilising properties are such as will enable the consumer to derive the greatest economical advantage from the use of Guano.

OHLENDORFF & CO.

OFFICES :—110, Fenchurch Street, London, E.C.
WORKS :—At Plaistow, near Victoria Docks.
DEPOTS :—In London, at the above Works, and at the principal Outports.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, May 28, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 240, Vol. 10] THURSDAY, JUNE 4, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

LONDON INTERNATIONAL EXHIBITION

AND ROYAL ALBERT HALL, SOUTH KENSINGTON, 1874

OPEN DAILY, 10 a.m to 6 p.m.

MILITARY BAND

At Three every THURSDAY and SATURDAY.

PERFORMANCE on the GRAND ORGAN

By Mr. WILLIAM CARTER, DAILY at 4.

EXHIBITION OF WINE

(Tasting permitted)

OPEN DAILY, Twelve to Five. Season Ticket holders admitted WITHOUT EXTRA CHARGE. Other Visitors will be charged 6d extra to the Cellars.

TECHNICAL INSTRUCTION.

Packets of FIFTY TICKETS may be purchased for Schools at 3d. each Ticket, and for Artisans at 6d each Ticket, admissible to the INTERNATIONAL EXHIBITION and ROYAL ALBERT HALL EVERY DAY except WEDNESDAY, from Ten to Six.

SCHOOL OF COOKERY.

LECTURE (with Practical Illustrations) by Mr. BUCKMASTER, every SATURDAY at Three.

GRAND OPERA CONCERT

On SATURDAY, June 6, at Three.

ADMISSION to the EXHIBITION and ALBERT HALL, 1s. Daily. (Wednesdays, 2s. 6d.)

PHYSICAL SOCIETY.—The Next Meeting is POSTPONED until June 13th, when Wm. Spottiswoode, Esq. F.R.S., will make a Communication "On the Combination of Colours by Polarised Light."

On June 30th Wm. Crookes, Esq F.R.S., will exhibit to the Society his Experiments on "Attraction and Repulsion accompanying Radiation."

E. ATKINSON, } *Secs.*
A. W. REINOLD, }

ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN AND IRELAND,

4, St. Martin's Place, Trafalgar Square, W.C.

(In which are united the Anthropological Society of London and the Ethnological Society of London.)

President	Prof. Busk, F.R.S.
Treasurer	Rev. Dunbar I. Heath, M.A.
Director	E. W. Brabrook, Esq. F.S.A.

The Institute will meet on Tuesday, June 9th, at 8 o'clock p.m. precisely, when the following Papers will be read.—

1.—"Note on the Discovery of Stone Implements in Egypt." By Sir John Lubbock, Bart., F.R.S.

2.—"On the Ethnology of Egypt." By Professor Richard Owen, M.D. F.R.S., &c.

J. FRED. COLLINGWOOD, *Secretary.*

THE MIDDLESEX HOSPITAL.—Mr. MORRIS, M.A. M.B. F.R.C.S., will give a Course of Instruction in OPERATIVE ENERGY during the present and ensuing months, adapted for the Army, Navy, and Indian Services, and for the Fellowship of the College of Surgeons. Fee, including expenses, £5 5s.

PRELIMINARY EXAM. IN ARTS, COLL. SURG., June 1874.

MR. HANBURY, M.A., Wrangler and late Senior Scholar of his College, will shortly begin to read with Classes for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has passed several Pupils for this Examination, to whom references are allowed. An early Class will commence towards the latter part of February, and a later one about Lady Day. Fee for the Course, from 7 to 12 guineas, according to the time of commencement and number of subjects taken up.—Address, 24 Old Square, Lincoln's Inn, W.C.

MATRICULATION EXAMINATION, LOND. UNIV., June 1874

MR. HANBURY, M.A., Wrangler and late Senior Scholar of his College, reads with Pupils for this Examination. Mr. Hanbury is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Examination, having passed fifty-three Pupils, to whom references can be given. An early class will commence the middle of February, and a later one about Lady-day. Fees for the two, 14l. and 10l. 10s. respectively. For further particulars, address to 24, Old Square, Lincoln's-inn, W.C. Two of Mr. Hanbury's pupils passed the Matriculation Examination in January 1873, in the Honours list, seventh and fourteenth respectively.

A few Residents can be accommodated in Mr. Hanbury's house, at Clapham.

SCIENTIFIC BOOKS.—A few copies can still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Conchiliorum, Tankerville Cat., &c., &c., as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c. &c. SOWERBY, 167A, Strand.

UNIVERSITY COLLEGE, TORONTO.—Applications will be received up to August 15th from Candidates for the PROFESSORSHIP of NATURAL HISTORY in this College. The initial salary is £550 currency per annum, rising to £700 currency by additions of £50 currency at intervals of five years The applications, with testimonials (originals or certified copies) are to be addressed to the Hon ARCHIBALD MCKELLAR, Provincial Secretary, Toronto, Ontario, in envelopes marked "Natural History," and should be posted so as to reach him on or before August 15

The Academic Year of the College will begin on October 1st, and Lectures will begin on October 5th

JOHN McCAUL, LL.D, President.

University College, Toronto, May 2nd, 1874.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate Analyses and investigations conducted—Apply to Prof. E V. GARDNER, F.E.S, F.S A., 44, Berners Street, W

PRIVATE TUITION.—A Clergyman, of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS Home comforts combined with great educational advantages. The highest references—M A., care of Editor of NATURE, 29, Bedford Street, Strand, W.C.

SCIENCE TUITION by CORRESPONDENCE—For Terms, apply to D C L, care of Macmillan & Co, 29, Bedford Street, Strand, London, W.C

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education Highest References can be given.—Address, M.A.H, care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W C.

NATURAL SCIENCE MASTERSHIP WANTED after July 31 next by a Graduate of Cambridge, in a first-rate Grammar School The highest testimonials—Address, M A., care of NATURE, 29, Bedford Street, Covent Garden, London, W C.

A YOUNG LADY seeks a RE-ENGAGEMENT as GOVERNESS in London. She is capable of teaching the rudiments of NATURAL SCIENCE, and has a thorough knowledge of French, German, and the usual branches of a sound English Education. —Address, Miss K., NATURE Office, 29, Bedford Street, Strand, W C.

REQUIRED, a MATHEMATICAL and NATURAL SCIENCE MASTERSHIP in a good School, by a CAMBRIDGE HONOUR-MAN.—Address—Alpha, care of the Publishers of NATURE, 29, Bedford Street, Strand, W.C

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D W., Doctor's Cottages, South Shore, Blackpool.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X.Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS Must all be well authenticated.—Apply, stating terms, to E E B, care of Messrs. MACMILLAN and Co., Bedford Street, Strand, W.C.

TO NATURALISTS and GEOLOGISTS.—Collections of the beautiful Fossils from a lately-made Cutting near Orford Castle, Suffolk (see Advertisement in NATURE, May 14th), are now being forwarded to the Subscribers Lists of the Fossils, with other particulars, can now be had by addressing (with stamped envelope) Fredc. Collingwood, Esq, F G S., 4, St Martin's Place, Trafalgar Square. A secure postal-box, with specimens from the Orford Castle Cutting, of Nassa granulata, Trophon muricatum, Tectura virginea, and Emarginula fissura, will be forwarded on receipt of twelve postage-stamps.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO, LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

ICE SAFES & WENHAM LAKE ICE.

THE

WENHAM LAKE ICE COMPANY'S CELEBRATED ICE

(In Town or Country),

American Ice, Water Pitchers, Ice Butter Dishes, Ice Cream Machines.

PRIZE MEDAL & NEW DUPLEX REFRIGERATORS,

Fitted with Water Tanks and Filters, and all Modern Improvements,

CAN BE OBTAINED ONLY AT THE SOLE OFFICE,

THE WENHAM LAKE ICE COMPANY,

125, STRAND, LONDON, W C. (CORNER OF SAVOY STREET)

Illustrated Price Lists free.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

JAMES WOOLLEY, SONS, & CO.,

69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,

For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS

For the various Public Examinations.

Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV From 10s. each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO, 292 Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free SALMON ODY & CO., 292, Strand, London

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 „ ... ... One Guinea.
Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.
Detailed Catalogues post-free.

Now ready,
NEGRETTI & ZAMBRA'S
NEW ENCYCLOPÆDIC CATALOGUE
Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard
METEOROLOGICAL INSTRUMENTS,
Containing very numerous Comparative Tables of Reference, and illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5*s*. 6*d*.
NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,
HOLBORN VIADUCT,
45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

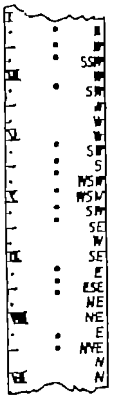
RUPTURES.—BY ROYAL LETTERS PATENT
WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,
JOHN WHITE, 228, Piccadilly,
Price of a Single Truss, 16*s*., 21*s*., 26*s*. 6*d*., and 31*s*. 6*d*.
„ Double „ 31*s*. 6*d*., 42*s*., and 52*s*. 6*d*.
„ Umbilical „ 42*s*. and 52*s*. 6*d*.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,
&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s* 6*d*., 7*s*. 6*d*., 10*s*., and 16*s*. each. Postage free.
JOHN WHITE, Manufacturer, 228, Piccadilly, London.

NEW ELECTRICAL ANEMOMETER.
NO SHAFT REQUIRED.
INVENTED BY
J. E. H. GORDON, CAIUS COLLEGE, CAMBRIDGE.

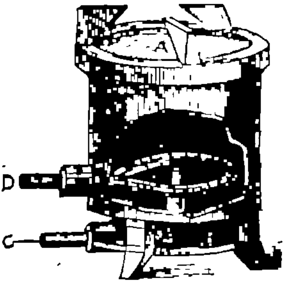
Mr. APPS is now prepared to supply these Instruments complete with wires and six-celled battery at the following prices:—
No. I. to indicate direction on an 8-in. dial, £30.
No. II to indicate direction and velocity on dials, £50.
No. IV. to indicate direction, and print direction and velocity, £100.
In these instruments the communication between the vane and dial is made by 3 or 4 insulated wires.
The battery has to be recharged once in 5 months (about).
The paper can be cut off as soon as desired, but the reels only require refilling once a in months.
The registering instrument can be placed at any distance from the fans or cups.
The clock of the recording instrument being fitted with a dial, there is no necessity for a timepiece for general purposes.
This instrument is now to be seen at work in connection with the Society of Arts' Testing Rooms, International Exhibition, South Kensington, and a
No. IV. Anemometer may now be seen in action at
A. APPS,
433, STRAND, LONDON, W.C.



Specimen of Record Slip. Each dot represents one mile of wind. (About half-size)

1871.—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873.—INTERNATIONAL EXHIBITION PRIZE MEDAL.

FLETCHER'S
NEW LOW TEMPERATURE BURNER (PATENT)



This Burner gives a range of heating power from a gentle current of WARM air to a BRIGHT RED HEAT, and is so perfectly under control that a common glass bottle may be placed on the tripod without protection and heated to any required temperature without the slightest risk of fracture. In practical use it dispenses with the necessity for drying-closets, sand-and-water baths, &c.
For very low temperatures the ring must be lighted through the opening B, this causes a current of warm air to rise through the gauze above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube.
Price, without blast tube 7*s* 6*d*
„ with blast tube for high temperatures ... 9*s*. 0*d*.

UNIVERSAL FURNACE (GAS),
For High Temperatures (without blast) for Crucibles, Muffles, &c., in several sizes and patterns. Special designs made to order
NEW BUNSEN BURNERS, giving a range of temperature up to a clear white heat, 10*s* 6*d*.
HOT BLAST BLOWPIPES, giving temperatures exceeding the fusing-point of platinum, 11*s* 6*d*, 13*s*, 15*s*
POWERFUL FOOT-BLOWERS, 18*s*
Drawings and description from dealers in Chemical Apparatus, or from
THOMAS FLETCHER, F.C.S.,
13 & 15, SUEZ STREET,
WARRINGTON.

JUDSON'S DYES.—18 Colours, 6d. each.
RIBBONS, WOOL, SILK, FEATHERS,
Completely dyed in 10 minutes without soiling the hands.
Full Instructions supplied. Of all Chemists and Stationers

JUDSON'S DYES.—Dyeing at Home.—
JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper
Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses,
Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A
Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—
Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record Light Brown for mahogany colour is excellent. No. 2 Black for walnut, Canary for satin, also black, lavender, magenta, and many other colours.
SIXPENCE PER BOTTLE
Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

NATURE.—Wanted clean Copies of Nos.
10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c., and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden
Landscape Gardening.
The Fruit Garden.
Garden Structures
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs
Hardy Flowers
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

THE JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

The QUARTERLY JOURNAL of CONCHOLOGY.

—Conducted by WM. NELSON and J. W. TAYLOR, of Leeds. No 2 now ready, containing numerous Papers on SHELLS. Price 6d per Number, or 2s. per Annum, post-free.—LEEDS: T. BARMLEY, BRIGGATE. LONDON: ROBERT HARDWICKE, 192, PICCADILLY, W.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B., F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s. 6d. bound in cloth): also covers for the volume (price 1s.), and back numbers

---

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations.

Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible].)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests.

Subscription, 16s. 6d. per annum, post free, dating from any quarter-day. Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

PRICE EIGHTEENPENCE.

THE PRACTITIONER:

A Monthly Journal of THERAPEUTICS.

Edited by FRANCIS E. ANSTIE, M.D., F.R.C.P., Senior Assistant Physician to Westminster Hospital, and Lecturer on Materia Medica in Westminster Hospital School.

No. LXXII. for JUNE 1874, Contains—

Original Communications:—

E. J. SHEARMAN, M.D. M.R.C.P.—"Two cases of Lead-poisoning, with with very large quantities of Albumen in the Urine."

T. LAUDER BRUNTON, M.D. Sc.D.—"On the Action of Purgative Medicines."

W. I. MICKLE, M.D.—"Notes on Potassic Bromide."

Dr ANSTIE—Prognosis and Treatment of Cholera."

FREDERICK T. ROBERTS, M.D. B.Sc. M.R.C.P.—"On 'Rest' in the Treatment of Chest Affections."

Reviews, Extracts from British and Foreign Journals, Notes and Queries—Correspondence

DEPARTMENT OF PUBLIC HEALTH

Sanitary Legislation for Ireland—The College of Physicians' Memorial on Overcrowding—The International Exhibition: Sanitary Appliances.—1. Automatic Sewage Arrangements—The Exceptional Temperature of the past Winter (1873–74).

MACMILLAN & CO., 29 & 30, Bedford Street, Covent Garden, London.

SAMPSON LOW, MARSTON, & CO.'S NEW PUBLICATIONS.

NOTICE.

The Second Edition of Stanley's "Coomassie and Magdala" is now ready.

COOMASSIE AND MAGDALA: a Story OF TWO BRITISH CAMPAIGNS IN AFRICA. Demy 8vo Maps and Illustrations, 16s. Second Edition. [Ready this day.

NOTICE

The Second Edition of Schweinfurth's "Heart of Africa" is now ready

The HEART of AFRICA; or, Three Years' Travels and Adventures in the Unexplored Regions of the Centre of Africa By Dr GEORG SCHWEINFURTH Translated by ELLEN E. FREWER. Two vols. 8vo, upwards of 500 pages each, 130 Woodcuts from Drawings made by the Author, and Two Maps, 42s [Second Edition at press.

N B —The Text is Translated from the Author's Unpublished Manuscript.

*** A Pamphlet containing the principal Reviews, is in preparation, and will be forwarded gratuitously on application.

New Work on the Recent Russian Campaign, by the only Civilian who has ever entered Khiva.

CAMPAIGNING on the OXUS and the FALL of KHIVA. By J A. MACGAHAN. With Map and numerous Illustrations. Demy 8vo, cloth extra, 16s. [Nearly ready.

Contains:—

Part I.—Life among the Kirghiz of the Kyzil Kum
,, II.—The Fall of Khiva: Campaign against the Turcomans.
Life in Khiva. Customs, Manners, and Forms of Governments, Medressés, and Bazaars.
Character of Russian Officers and Soldiers.
Personal Adventures.
Short Account of Previous Campaigns.
,, III.—Campaign against the Turcomans.

The CHINA COLLECTOR'S POCKET COMPANION. By Mrs. BURY PALLISER. With upwards of 1,500 Illustrations of Marks and Monograms. Small post 8vo, limp cloth, 5s.

"I know it by that mark."—*Pericles, Prince of Tyre.*

*** A portable Book of Marks and Monograms is a necessary complement to the extensive ceramic works of the present day.

New work by the Great Traveller, GERHARD ROHLFS, Gold Medalist of the Royal Geographical Society.

ADVENTURES in MOROCCO and JOURNEYS through the OASES of DRAA and TAFILET. By Dr GERHARD ROHLFS. Edited by WINWOOD READE. In One Vol. demy 8vo, Map, and Portrait of the Author, cloth extra. [Ready.

AFRICA: Geographical Exploration and Christian Enterprise, from the Earliest Times to the Present By J. GRUAR FORBES. Crown 8vo. cloth extra, 7s. 6d. [This day.

EARLY RUSSIAN HISTORY. By W. R. S. RALSTON. Crown 8vo, cloth extra, 5s. [Nearly ready.

MEMOIR OF DR. LIVINGSTONE.
By H. M. STANLEY.
See

HOW I FOUND LIVINGSTONE. 7s. 6d, crown 8vo cloth extra, uniform with the cheap edition of Major Butler's "The Great Lone Land," &c This Edition contains all the small and some of the large Illustrations, and a long Introductory Chapter on the DEATH OF LIVINGSTONE, with a brief Memoir, and extracts from Dr Livingstone's Last Correspondence with Mr. Stanley not yet published.

*** This Edition has been revised most carefully from beginning to end, and all matter of a personal or irrelevant character omitted.

N.B.—Copies of the Original Edition, cloth extra, gilt edges, may be had, 10s. 6d.

The WILD NORTH LAND: the Story of a Winter Journey with Dogs across Northern North America By Major W. F. BUTLER, C B., Author of "The Great Lone Land." Demy 8vo. cloth, with numerous Woodcuts and a Map. Fourth Edition, 18s. [Now ready.

ILLUSTRATIONS of CHINA and ITS PEOPLE. By J THOMPSON, F R G S Being Photographs from the Author's Negatives, by the Autotype Process 200 Photographs, with Letter-press Descriptions. Four vols. imperial 4to, price £3 3s. each volume.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, Crown Buildings, 188, Fleet Street.

L. REEVE & CO.'S NEW WORKS.

Dedicated by Special Permission to H R.H. the PRINCESS of WALES

A MONOGRAPH of ODONTOGLOSSUM; a Genus of the Vandeous Section of Orchidaceous Plants By JAMES BATEMAN, Esq. F.R.S. F.L S Part VI., completing the Work, 21s. Also the Work complete in 1 vol imperial folio, with 30 elaborately Coloured Plates, forming one of the most beautiful floral works ever published, half morocco, gilt edges, £7 7s.

NATURAL HISTORY of PLANTS. By Professor H. BAILLON, Pres. L S Paris. Translated by M. M. HARTOG, B.Sc. B.A. Vol. III. with 531 Wood Engravings, 25s.

ORCHIDS and HOW to GROW THEM in India and other Tropical Climates. By SAMUEL JENNINGS, F L S F R H S., late Vice-President of the Agri-Horticultural Society of India. Parts I. to IV., each with 4 Coloured Plates, 5s.

BOTANICAL MAGAZINE: Figures and Descriptions of New and Rare Plants. By Dr. HOOKER, C B. F.R.S. Monthly, with 6 Coloured Plates, 3s. 6d., Annual Subscription, 42s.

*** Re-issue, Vols I to VI, each 42s; to Subscribers for the entire Series, 36s.

FLORAL MAGAZINE. New Series, enlarged to royal 4to. Figures and Descriptions of the Choicest New Flowers for the Garden, Stove, or Conservatory. Monthly, with 4 Coloured Plates, 3s. 6d., Annual Subscription, 42s.

CONCHOLOGIA ICONICA: Figures and Descriptions of the Shells of the Mollusca. By LOVELL REEVE, F.L.S., and G. B. SOWERBY, F L S. Double Part, 314 and 315, with 16 Coloured Plates, 4to, 20s.

LAHORE to YARKAND: Incidents of the Route and Natural History of the Countries traversed by the Expedition of 1870 under T. D. Forsyth, Esq C.B. By GEORGE HENDERSON, M D. F L S. F R.G.S., and ALLAN O'HUME, Esq C.B. F.Z S. With 32 Coloured Plates of Birds and 6 of Plants, 26 Photographic Views of the Country, and a Map of the Route, 42s.

HARVESTING ANTS and TRAPDOOR SPIDERS: Notes and Observations on their Habits and Dwellings. By J. T. MOGGRIDGE, F.L.S. Coloured Plates, 10s. 6d

INTERNATIONAL SERIES of ELEMENTARY TEXT-BOOKS on NATURAL SCIENCE. No. 1—Zoology By ADRIAN J. EBELL, Ph B. M D. 1s.

YOUNG COLLECTOR'S HANDYBOOKS. By the Rev H. P DUNSTER. Cuts. I. Botany. II. Recreative Science. Each 3s. 6d.

NEW SERIES of NATURAL HISTORY

FOR BEGINNERS AND AMATEURS

BRITISH INSECTS. By E. F. Staveley. 16 Coloured Plates, 14s
BRITISH BUTTERFLIES and MOTHS. By H. T. Stainton. 16 Coloured Plates, 10s. 6d.
BRITISH BEETLES. By E. C. Rye 16 Coloured Plates, 10s. 6d
BRITISH BEES By W. F. Shuckard. 16 Coloured Plates, 10s. 6d
BRITISH SPIDERS. By E. F. Staveley 16 Coloured Plates, 10s. 6d.
BRITISH FERNS. By M. Plues. 16 Coloured Plates, 10s 6d.
BRITISH GRASSES. By M. Plues. 16 Coloured Plates, 10s 6d.
BRITISH SEAWEEDS. By S O Gray. 16 Coloured Plates, 10s 6d.
OUTLINES of BOTANY. By G. Bentham. 2s. 6d.
BRITISH WILD FLOWERS. By T. Moore. 24 Coloured Plates, 16s.

HANDBOOK of the BRITISH FLORA. By G. BENTHAM, F.R.S. P.L.S New Edition, 12s.

DOMESTIC BOTANY: an Exposition of the Structure and Classification of Plants, and of their Uses for Food, Clothing, Medicine, and Manufacturing Purposes. By JOHN SMITH, A.L.S. 16 Coloured Plates, 16s.

BRITISH MOSSES. By M. J. Berkeley. 24 Coloured Plates, 21s.

BRITISH FUNGOLOGY. By M. J. BERKELEY. 24 Coloured Plates, 30s.

BADHAM'S ESCULENT FUNGUSES. New Edition By F. CURREY. 12 Coloured Plates, 12s

The TOURIST'S FLORA: a Descriptive Catalogue of the Flowering Plants and Ferns of the British Islands, France, Germany, Switzerland, Italy, and Italian Islands. By JOSEPH WOODS, F.L S. 18s

L. REEVE & CO., 5, Henrietta Street, Covent Garden

A FEW ARTIST'S PROOFS
OF
THE PORTRAIT OF CHARLES DARWIN, F.R.S.
(ENGRAVED ON STEEL BY CHAS. H. JEENS),
Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,
PRICE 5s. EACH,
OR THROUGH ANY BOOKSELLER.

DAVID HUME'S PHILOSOPHICAL WORKS.

Now ready, in 2 vols 8vo, cloth, price 28s.

A TREATISE on HUMAN NATURE,
being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects; and Dialogues concerning Natural Religion By DAVID HUME. Edited, with Preliminary Dissertations and Notes, by T. H. GREEN, M.A., Fellow and Tutor, Ball. Coll. Oxford, and the Rev. T. H. GROSE, M.A. Fellow and Tutor, Queen's Coll. Oxford.

In the Autumn, in 2 vols. 8vo, uniform,

HUME'S ESSAYS, MORAL, POLITICAL, and LITERARY, with Notes, &c., by the same Editors.

*** These four volumes will form a New and Complete Edition of DAVID HUME'S "Philosophical Works," to be had in Two separate Sections, as above announced.

London: LONGMANS, GREEN, & CO., Paternoster Row.

LIGHT SCIENCE for LEISURE HOURS,
by R. A. PROCTOR, B.A. Two Series of Essays:—

First Series, including the Aurora, Storms, Magnetism, Betting on Races, &c., 7s. 6d.

Second Series, including Life of Mary Somerville, Gulf Stream, Climate of Britain, &c., 7s. 6d.

London: LONGMANS, GREEN, & CO., Paternoster Row.

LETTERS from H.M.S. "Challenger,"
By Professor WYVILLE THOMSON, with numerous Illustrations, are now appearing in *Good Words*. Sixpence Monthly, illustrated.

Now ready, at all the Libraries.

SOUTH by WEST: or, Winter in the Rocky Mountains and Spring in Mexico.

Edited by the Rev. CANON KINGSLEY.

With numerous Illustrations. Demy 8vo, 16s.

From the *Times*, May 30, 1874.

"One of the most fresh and pleasant, and in some respects the most original, volumes of travel that has perhaps ever fallen from a young lady's pen. As we close her book, with all its bright and pleasant sketches, rich with the true light of the sunny south fresh before our eyes . . . we have to thank the writer for introducing us once again to the marvellous history of Mexico—a history which can never lose its charm while the English language is spoken."

WORKS BY THE REV. CHARLES KINGSLEY,
Canon of Westminster.

HEALTH and EDUCATION. Second Thousand.
Crown 8vo, 7s. 6d.

"Those who see the importance of translating the precepts of physiology from a scientific 'tongue not understanded of the people' into plain and forcible English, may well rejoice that Mr. Kingsley has taken up the cause." *Pall Mall Gazette*.

TOWN GEOLOGY. Fourth Thousand.
Crown 8vo, 5s.

"A masterpiece of scientific exposition"—*Echo*.

W. ISBISTER & CO., 56, Ludgate Hill, London.

Illustrated by 760 Wood Engravings and Three Coloured Plates, and accompanied by a Series of Problems, medium 8vo, cloth, 18s.

DESCHANEL'S NATURAL PHILOSOPHY:
an Elementary Treatise. Translated and edited, with extensive Additions, by J. D. EVERETT, D.C.L. F.R.S., Professor of Natural Philosophy in the Queen's College, Belfast.

Also separately, in Four Parts, limp cloth, 4s. 6d. each:—Part I. Mechanics, Hydrostatics, and Pneumatics. Part II. Heat. Part III. Electricity and Magnetism. Part IV. Sound and Light.

"Systematically arranged, clearly written, and admirably illustrated; it forms a model work for a class in experimental physics."—*Saturday Review*.

With 21 Wood Engravings and Two Maps, post 8vo, cloth, 4s. 6d.

The YELLOWSTONE REGION in the ROCKY MOUNTAINS, as EXPLORED in 1870–71.
Described and Illustrated. Edited by JAMES RICHARDSON.

"No one with the soul of a traveller can read this book without longing at once to start for the 'Yellowstone.'"—*Times*.

With 126 Wood Engravings, post 8vo, cloth, 4s. 6d.

DIAMONDS and PRECIOUS STONES.
From the French of LOUIS DIEULAFAIT.

"A vast storehouse of information as to the properties of brilliants, and graphic accounts of the various processes through which they pass"—*John Bull*.

London: BLACKIE & SON, Paternoster Buildings.

Eighth Thousand, cloth, 21s., 70 Plates, 4 Coloured.

HOW TO WORK WITH THE MICROSCOPE.
A complete Manual of Microscopical Manipulation. A full description of many new processes of investigation, taking photographs, &c.

HARRISON, Pall Mall.

BY DR. LIONEL BEALE, F.R.S.

1. **PROTOPLASM.—I. Dissentient. II. Demonstrative. III. Speculative.** 3rd Edition, 16 Coloured Plates, 10s. 6d. [*Now ready*.
2. **BIOPLASM, or Living Matter. 22 Plates.** 6s. 6d.

London: J. & A. CHURCHILL.
Philadelphia: LINDSAY & BLAKISTON.

MACMILLAN'S MAGAZINE.
No. 176. FOR JUNE.

PRICE 1s.

CONTAINS—

1.—"Recent Works on the Buildings of Rome" By Edward A. Freeman.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XI.—XIII.
3.—"Church Reform."
4.—"To the Unreturning Brave"
5.—"The Homes of the London Poor." By Miss Octavia Hill.
6.—"Female Suffrage." By Prof. Goldwin Smith.
7.—"Masters of Etching." By Fredk. Wedmore.
8.—"Not Lost."
9.—"Mr. Froude's 'English in Ireland.'" By W. E. H. Lecky.

MACMILLAN & CO., London.

DIARY OF SOCIETIES.

London

THURSDAY, June 4.

Chemical Society, at 8.—On Dendritic Spots: H. Adrian.—On the Acidity of Normal Urine: J. Reoch.—On certain compounds of Albumen with Acids: G. S. Johnson.—On a simple form of Apparatus for estimating Urea in Urine: Dr. W. J. Russel and S. H. West.—On Ipomœic Acid: E. Neison and J. Bayne.—On the Action of Chlorine and Bromine on Isodinaphthyl: W. Smith.—On Acetyl Sulphite and On a new formation of Toluol: Dr. D. Tommasi.

Society of Antiquaries, at 8.30.—Ballot for Fellows.

Royal Institution, at 3.—Crystals: N. S. Maskelyne.

Horticultural Society.—Great Summer Show.

FRIDAY, June 5.

Royal Institution, at 9.—Venus's Fly-Trap (*Dionæa muscipula*): Dr. Burdon Sanderson.

Horticultural Society, at 2.—Great Summer Show.

Geologists' Association, at 8.—On the Lower Greensand and Gault in the neighbourhood of Folkestone: F. G. H. Price, F.G.S.—On a Collection of Fossils from the Upper Greensand of Marden, Cambs.: H. George Fordham, F.G.S.

SATURDAY, June 6.

Royal Institution, at 3.—The Planetary System: R. A. Proctor.

Junior Philosophical Society, at 3.—Visit to the British Museum.

TUESDAY, June 9.

Photographic Society, at 8.—Gelatine as a Vehicle for Salts in the production of Negatives: J. King.—The Gelatino-bromide process: R. Kennett.—Alkaline Development: Col. Stuart Wortley.

Anthropological Institute, at 8.—Note on the Discovery of Stone Implements in Egypt: Sir John Lubbock, Bart., F.R.S.—On the Ethnology of Egypt: Prof. Richard Owen, F.R.S.—The Batchás of Central Asia: Dr. Eugene Schuyler.—Ethnic Psychology: Robert Dunn, F.R.C.S.

WEDNESDAY, June 10.

Geological Society, at 8.

THURSDAY, June 11.

Mathematical Society, at 8.—Parallels of Developables and of Curves of Double Curvature: S. Roberts.—A remarkable relation between the difference of two Fagnanian Arcs of an Ellipse of Eccentricity e and that of two corresponding Arcs of a Hyperbola of Eccentricity $\frac{1}{e}$: J. Griffiths.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in Nature of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of Nature *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

Office—29, BEDFORD STREET, STRAND.

"*NATURE.*"

Nearly all the Back Numbers of Nature may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to Advertisements should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.

Pillischer's St. Thomas's Hospital Microscope,

As supplied to the principal Universities and Hospitals.

Monocular, £5; Binocular, £10 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from $\frac{1}{4}$ to $\frac{1}{50}$ inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14*s.*, 4½ in., 17*s.*; 6 in., in Wooden Case, 10*s.*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. Ellis & Son, Ruthin, North Wales.

LONDON AGENTS;—W. Best & Sons, Henrietta Street, Cavendish Square.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern, packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 . 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5	5	0

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

In the Press

THE ELEMENTS OF EMBRYOLOGY.

By MICHAEL FOSTER, M.A., F.R.S.,

Prælector in Physiology at Trinity College, Cambridge; and

F. M. BALFOUR, Scholar of Trinity College, Cambridge.

MACMILLAN & CO., LONDON

IN THE PRESS.

ISMAILÏA

A NARRATIVE OF

THE EXPEDITION TO CENTRAL AFRICA

FOR THE SUPPRESSION OF

THE SLAVE TRADE.

ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.

By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,

Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.

MACMILLAN & CO., LONDON.

Just Published. 8vo. Price 14*s.*

A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS; OR, ORGANIC CHEMISTRY.

By C. SCHORLEMMER, F.R.S.,

LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.

"Nor is Mr. Schorlemmer appreciated by the profession for his experimental researches only; his fame is even more widely spread by his 'Manual of Organic Chemistry.' This is one of the favourite works from which the present generation of young chemists derive their information. Having myself to teach a large class of students, I have continuous opportunities of recommending this work and of observing the benefit derived from this recommendation."—PROF HOFMANN.

London: MACMILLAN AND CO.

This day, in 8vo, price 7*s.* 6*d.*

THEORY of the GLACIERS of SAVOY.

BY M. LE CHANOINE RENDU,

Translated by ALFRED WILLS, Q.C., Late President of the Alpine Club.

To which are added the Original Memoir, and Supplementary Articles by PROFESSOR TAIT and JOHN RUSKIN, D.C.L. Edited, with Introductory Remarks, by GEORGE FORBES, B.A., Professor of Natural Philosophy in the Andersonian, University, Glasgow.

In 8vo, price 16*s.*

THE LIFE AND LETTERS OF JAMES DAVID FORBES, F.R.S.,

LATE PRINCIPAL OF THE UNITED COLLEGE IN THE UNIVERSITY OF ST. ANDREWS.

By JOHN CAMPBELL SHAIRP, LL.D., Principal of the United College in the University of St. Andrews; PETER GUTHRIE TAIT, M.A., Professor of Natural Philosophy in the University of Edinburgh; and A. ADAMS-REILLY, F.R.G.S.

With Portraits, Maps, and Illustrations.

"It has seldom been our good fortune to peruse a biography so entirely satisfactory as that contained in the present volume. There were a wonderful simplicity and unity in the character and career of Principal Forbes, and in this delightful memoir the living man is so faithfully represented, that those who had only known him as the indefatigable physicist, the demonstrator, if not the actual discoverer of the phenomena of glacier structure and motion, or those whom his career never reached, will here find themselves introduced to a personal acquaintance; while his many friends and loyal students will gratefully acknowledge that Prof. Shairp and his able coadjutors have done their work wisely and well. At once a graceful literary monument to the memory of a good man, and an exhaustive scientific manual on the special subjects to which Forbes's life was consecrated."—*Spectator.*

MACMILLAN AND CO., London.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr. Lankester, September 10, 1867; Dr. Letheby, February 15, 1865, and December 1872.

Home Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10*s.* and upwards. Portable Filters on this system, £1 5*s* to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10*s.* 6*d.* and 21*s.* each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4*s.* 6*d* to 6*s.* each. Household and Fancy Filters from 12*s.* 6*d.*

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,

157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2*d.*

CHAPMAN & HALL'S WORKS.

NEW WORK BY PROFESSOR OLIVER.

ILLUSTRATIONS of the PRINCIPAL NATURAL ORDERS of the VEGETABLE KINGDOM Prepared for the Science and Art Department of the Council of Education. By Professor OLIVER, F.R.S F.L.S. Oblong 8vo, with 109 Plates. Price, plain, 16*s*, coloured, 26*s*. [This day.

The CAUSE of the SUPPOSED PROPER MOTION of the FIXED STARS With other Geometrical Problems in Astronomy hitherto unsolved. By Lieutenant-Colonel DRAYSON, R.A. F.R A.S., Author of "Practical Military Surveying," &c. Demy 8vo, 10*s*. [This day.

The CAUSE, DATE, and DURATION of the LAST GLACIAL EPOCH of GEOLOGY With an Investigation of a new Movement of the Earth By Lieutenant-Colonel DRAYSON, R.A. F.R A.S Demy 8vo, 10*s*.

The EARTH. A Descriptive History of the Phenomena and Life of the Globe By ELISEE RECLUS. Edited by the late B B WOODWARD. With 234 Maps and Illustrations, and 24 page Maps printed in Colours. 2 vols. large demy 8vo, 26*s*

The OCEAN, ATMOSPHERE, and LIFE. Being the Second Series of a Descriptive History of the Life of the Globe. By ELISEE RECLUS. Translated by the late B. B. WOODWARD, and Edited by HENRY WOODWARD. 2 vols. large demy 8vo Illustrated with 250 Maps or Figures, and 27 Maps printed in Colours. Price 26*s*

CHAPMAN & HALL, 193, Piccadilly.

Second Edition, royal 8vo, cloth extra gilt, 31*s*. 6*d*.

The DEPTHS of the SEA: An Account of the General Results of the Dredging Cruises of H.M.SS. *Porcupine* and *Lightning* during the Summers of 1868-69-70, under the Scientific Direction of Dr. Carpenter, F.R.S., J. Gwyn Jeffries, F.R.S, and Dr. Wyville Thomson, F.R.S. By C WYVILLE THOMSON, F.R.S., &c., Director of the Civilian Scientific Staff of the *Challenger* Expedition. Illustrated by 8 Maps and Plates and nearly 100 Woodcuts

"The book is full of interesting matter, and is written by a master of the art of popular exposition It is excellently illustrated, both coloured maps and woodcuts possessing high merit. Those who have already become interested in the dredging operations will, of course, make a point of reading this work; those who wish to be pleasantly introduced to the subject, and rightly to appreciate the news which arrives from time to time from the *Challenger*, should not fail to seek instruction from Prof Thomson."—*Athenæum*.

Second Edition, royal 8vo, cloth extra, 31*s*. 6*d*.

The FORCES of NATURE: a Popular Introduction to the Study of Physical Phenomena. By AMEDEE GUILLEMIN. Translated from the French by MRS. NORMAN LOCKYER, and Edited, with Additions and Notes, by J. NORMAN LOCKYER, F.R.S Illustrated by 11 Coloured Plates and 455 Woodcuts.

"Translator and editor have done justice to their trust The text has all the force and flow of original writing, combining faithfulness to the author's meaning with purity and independence in regard to idiom, while the technical precision and accuracy pervading the work throughout speak of the watchful editorial supervision which has been given to every scientific detail. Altogether, the work may be said to have no parallel, either in point of fulness or attraction, as a popular manual of physical science."—*Saturday Review*.

Third Edition, royal 8vo, cloth extra, 21*s*.

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S. With Appendices, Engravings, Maps, and Chromolithographs.

"The illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations."—*Saturday Review*.

"The lectures themselves furnish a most admirable elementary treatise on the subject, whilst by the insertion in appendices to each lecture of extracts from the most important published memoirs, the author has rendered it equally valuable as a text-book for advanced students."—*Westminster Review*.

MACMILLAN & CO., LONDON.

THIS DAY, in 8vo, price 14*s*.

ESSAYS AND ADDRESSES.

BY

PROFESSORS & LECTURERS OF OWENS COLLEGE, MANCHESTER

Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873.

CONTENTS.

OPENING ADDRESS. By the Duke of Devonshire, K.G. F.R.S., President of the Court of Governors.

"On some Relations of Culture to Practical Life." By J. G. Greenwood, Principal and Professor of Greek.

"Original Research as a Means of Education." By H. E. Roscoe, F.R.S., Professor of Chemistry.

"Solar Physics." By Balfour Stewart, F.R.S., Professor of Natural Philosophy.

"The Sun's Distance from the Earth." By T. H. Core, Professor of Natural Philosophy.

"The Limits of Geological Knowledge." By W. Boyd Dawkins, F.R.S., Curator of the Natural History Museum, and Lecturer in Geology and Palæontology.

"The Use of Steam." By Osborne Reynolds, Professor of Engineering.

"Primeval Vegetation in its Relation to the Doctrines of Natural Selection and Evolution." By W. C. Williamson, F.R.S., Professor of Natural History.

"Science and Medicine." By A. Gamgee, F.R.S., Professor of Practical Physiology and Histology.

"Some Historical Results of the Science of Language." By A. S. Wilkins, Professor of Latin and Comparative Philology.

"The Talmud." By T. Theodores, Professor of Oriental and Modern Languages.

"Provencal Poetry in Old and Modern Times." By H. Breymann, Lecturer on French Language and Literature.

"The Recent Reorganisation of the English Law Courts, in its Relation to their Past History." By J. Bryce, D.C.L., Professor of Jurisprudence and Law.

"The Railways and the State." By W. Stanley Jevons, F.R.S., Professor of Logic, and Mental and Moral Philosophy, and Political Economy.

"The Peace of Europe.". By A. W. Ward, Professor of English and History.

MACMILLAN & CO., LONDON.

HENRY S. KING & CO.'S LIST.

This day, demy 8vo, cloth, 10s. 6d.

SENSATION and INTUITION.

Studies in Psychology and Æsthetics. By JAMES SULLY, M.A., One vol. demy 8vo, cloth.

CONTENTS:—The Relation of the Evolution Hypothesis to Human Psychology—New Theories of Emotional Expression—Recent German Experiments with Sensation—Belief; its Varieties and its Conditions—The Genesis of the Free-will Doctrine—On some Elements of Moral Self-culture—The Basis of Musical Sensation—Aspects of Beauty in Musical Form—The Nature and Limits of Musical Expression—The Æsthetic Aspects of Character—The Representation of Character in Art—Lessing's Hamburg Dramaturgy—On the Possibility of a Science of Æsthetics.

Dr. W. B. CARPENTER'S PRINCIPLES of MENTAL PHYSIOLOGY. With their Applications to the Training and Discipline of the Mind, and the Study of its Morbid Conditions. 8vo, illustrated, cloth, 12s.

PHYSIOLOGY for PRACTICAL USE. By various Writers. Edited by JAMES HINTON. 2 vols. crown 8vo with 50 Illustrations, cloth, 12s. 6d.

THE INTERNATIONAL SCIENTIFIC SERIES.

1. Professor Tyndall's Forms of Water in Clouds and Rivers, &c. Fourth Edition, illustrated, 5s.
2. Walter Bagehot's Physics and Politics. Second Edition, 4s.
3. Dr. Edward Smith's Foods. Third Edition, illustrated, 5s.
4. Professor Bain's Mind and Body. Third Edition, illustrated, 4s.
5. Herbert Spencer's Study of Sociology. Third Edition, illustrated, 5s.
6. Prof. Stewart's Conservation of Energy. Second Edition, illustrated, 5s.
7. Dr. J. B. Pettigrew's Animal Locomotion. Second Edition, illustrated, 5s.
8. Dr. Henry Maudsley's Responsibility in Mental Disease. Second Edition, 5s.
9. Prof. Josiah P. Cooke's New Chemistry. Second Edition, illustrated, 5s.
10. Prof. Sheldon Amos's Science of Law. Crown 8vo. [Immediately.

HENRY S. KING & CO., 65, Cornhill, and 12, Paternoster Row.

SMITH, ELDER, & CO.'S NEW BOOKS.

NEW EDITION OF DARWIN ON CORAL REEFS.

The STRUCTURE and DISTRIBUTION of CORAL REEFS. By CHARLES DARWIN, F.R.S. New and Revised Edition. [Nearly ready.

Now ready, with a Map, crown 8vo, 10s. 6d.

The STORY of the ASHANTEE CAMPAIGN. By WINWOOD READE, the *Times* Special Correspondent. Author of "The African Sketch Book," &c

*** This work is not a mere reprint of the Author's letters in the *Times*.

Extract from the Author's Preface.

"It was my fortune to see more fighting than anyone else in the expedition, excepting a few officers serving in the native regiments. Moreover, no other writer, military or civil, witnessed either of these three events—the Storming of Amoaful by the Black Watch; the Storming of Ordahsu by the Rifle Brigade; or the Taking of Coomassie by Sir Archibald Alison and Colonel McLeod. I witnessed these three events."

HOURS in a LIBRARY. By Leslie Stephen. Crown 8vo, 9s.

CONTENTS:—De Foe's Novels—Richardson's Novels—Pope as a Moralist—Mr. Elwin's Edition of Pope—Some Words about Sir Walter Scott—Nathaniel Hawthorne—Balzac's Novels—De Quincey.

MOHAMMED and MOHAMMEDANISM: Lectures delivered at the Royal Institution of Great Britain in February and March 1874. By R. BOSWORTH SMITH, M.A. Crown 8vo, 6s.

LITERATURE and DOGMA: an Essay towards a better Apprehension of the Bible. By MATTHEW ARNOLD. Fourth Edition, revised. Crown 8vo, 9s.

"This book, when it gets known, will become a power, against which one may set oneself in opposition, but with which one must reckon."—*Theological Review* of Leyden.

SWISS ALLMENDS and a WALK to SEE THEM: a Second Month in Switzerland. By F. BARHAM ZINCKE, Vicar of Wherstead, and Chaplain-in-Ordinary to the Queen. Crown 8vo, with a Map, 7s. 6d.

SANITARY ARRANGEMENTS FOR DWELLINGS, intended for the Use of Officers of Health, Architects, Builders, and Householders. With numerous Illustrations. By WILLIAM EASSIE, C.E. F.L.S. F.G.S. &c, Author of "Healthy Houses." Crown 8vo, with Illustrations, 5s. 6d.

London: SMITH, ELDER, & CO, 15, Waterloo Place.

NEARLY READY.

TELEGRAPH AND TRAVEL.

A NARRATIVE of the FORMATION and DEVELOPMENT of TELEGRAPHIC COMMUNICATION between ENGLAND and INDIA, under the Orders of Her Majesty's Government, with incidental Notices of the Countries through which the Lines pass.

By COLONEL SIR FREDERIC GOLDSMID, C.B., K.C.S.I.,

Late Director of the Government Indo-European Telegraph.

With numerous Illustrations and Maps. 8vo.

MACMILLAN & CO., LONDON.

VICHY WATERS COMPANY,

27, MARGARET STREET, REGENT STREET, LONDON, W.

DEPÔT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR JUNE 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF JUNE NUMBER—Our Illustrations:—1. "An Italian Beauty," by A. Boulard. 2. "The Pet Dog," by Verwée. 3. "The Oak," by G. Courbet.—Cut Metal Work and Printed Tin-Foil Decorations.—The Exhibitions.—Art Notes and Gossip.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

WORKS BY CHARLES DARWIN, F.R.S.

I.

The EXPRESSION of the EMOTIONS in MAN and ANIMALS. Crown 8vo, 12*s*, with Illustrations

II

The ORIGIN of SPECIES, by MEANS of NATURAL SELECTION, or, the Preservation of Favoured Races in the Struggle for Life. Post 8vo, 7*s*. 6*d*.

III.

The DESCENT of MAN, and on SELECTION in RELATION to SEX. With Illustrations. 2 vols crown 8vo, 24*s*.

IV.

THE VARIATION OF ANIMALS and PLANTS under VARIATION. With Illustrations 2 vols 8vo, 28*s*.

VI.

THE VARIOUS CONTRIVANCES by which ORCHIDS are FERTILISED by INSECTS, and on the Good Effects of Intercrossing. With Woodcuts. Post 8vo, 9*s*.

V.

A NATURALIST'S VOYAGE ROUND the WORLD; being a Journal of Researches into the Natural History and Geology of Countries visited. Post 8vo, 9*s*

FACTS and ARGUMENTS for DARWIN. By FRITZ MULLER. Translated by W. S. DALLAS, F L S. With Illustrations. Post 8vo, 6*s*.

JOHN MURRAY, Albemarle Street.

HOLLOWAY'S OINTMENT and PILLS.—Health Lost and Found.—After safely struggling through the winter, multitudes will fall victims to the throat and chest complaints so common in the spring If the first symptoms receive attention and judicious treatment, not only will future danger be averted, but old ailments will give way and better health will be attained than was enjoyed before the illness. No treatment for safety and certainty of success may be so confidently relied upon as that discovered by Professor Holloway, whose Pills and Ointment always restore the sufferer. While the Pills are taken in moderate doses, the Ointment should be well rubbed upon the skin, near the part affected, as actively as salt is rubbed into meat

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle.—*Athenæum*

"The chart cannot fail to be very useful to the keepers of horses and meat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading.

Price 6*d* per month, or 5*s* per annum, Post Free.

Vols. I., II, and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s*. 6*d*. each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED FROM AN ACRE OF SOIL by an Average Crop of Wheat, Oats, Barley, Turnips, &c; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C. and 47, MILLBANK STREET, S.W.

BRYANT & MAY'S
MATCHES.

NEW EDITION.

With the Latest Discoveries and Rectifications.

THE HANDY ROYAL ATLAS OF MODERN GEOGRAPHY.

By ALEX. KEITH JOHNSTON,
LL.D. F.R.S.E. F.R.G.S.
Author of the "Physical Atlas," the "Royal Atlas," &c.

Exhibiting the present condition of Geographical Discovery and Research in the several Countries, Empires, and States of the World.

Forty-six Maps, clearly printed and carefully coloured, with General Index.

In imperial 4to, half-bound morocco, 2*l.* 12*s.* 6*d.* This Edition contains a new Map of North Polar Regions.

"Is probably the best work of the kind now published."—*Times.*

"The ample illustrations of recent discovery, and of the great groups of dependencies on the British Crown, renders Dr. Johnston's the best of all Atlases for English use."—*Pall Mall Gazette.*

"The 'Handy Atlas' is thoroughly deserving of its name. Not only does it contain the latest information, but its size and arrangement render it perfect as a book of reference."—*Standard.*

By the same Author.

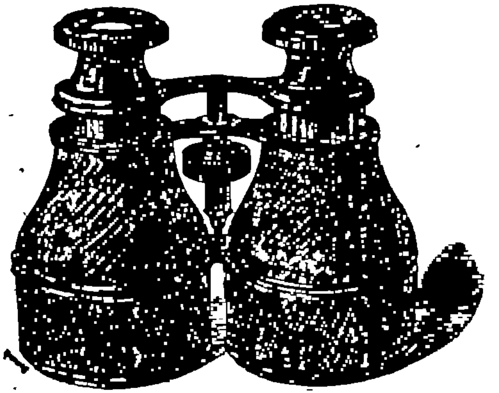
THE ROYAL ATLAS OF MODERN GEOGRAPHY

A Series of entirely Original and Authentic Maps, with Indices to each Map, comprising nearly 150,000 names of Places contained in the Atlas. A New Edition, brought up to the Present Time. Containing a New Map of North Polar Regions. In imperial folio, half-bound morocco, 5*l.* 15*s.* 6*d.*

"We know no series of maps which we can more warmly recommend."—*Saturday Review.*

WILLIAM BLACKWOOD & SONS, 45, George Street, Edinburgh; and 37, Paternoster Row, London.

BROWNING'S NEW BINOCULARS.



BROWNING'S NEW "PANERGETIC" OPERA, FIELD, and RACE GLASS, for general use, brilliant light, extensive field of view, and sharp definition.

THE "POLYCRATIC" OPERA, for distant objects, has 18 lenses, and possesses great power, with portability.

THE "EURYSCOPIC" OPERA, for the theatre, has the largest field of view, giving delightfully easy vision, 2*l.* 2*s.* New Illustrated List free.

ACHROMATIC BINOCULARS, from 15*s.*

NOTICES OF THE PRESS.

"Brings out figures with marvellous distinctness, and has a very large field of view, and so very many advantages over the other Binoculars that we have seen that we confidently award very high praise indeed."—*Popular Science Review.*

"Exhibits objects with remarkable brightness and sharpness."—*The Observer.*

"A wide extension of the field of view is attained, while even in misty weather objects are exhibited with wonderful clearness."—*Naval and Military Gazette.*

"A very extensive field of view is obtained, and objects in the distance are shown with great distinctness."—*English Churchman.*

JOHN BROWNING,

Optician to the Royal Observatory, the Royal Society, the Observatories of Kew, Cambridge, Melbourne, Utrecht, &c., &c., &c.

63, STRAND, W.C.

PRIZE MEDAL, 1862. ESTABLISHED 100 YEARS.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, June 4, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 241, Vol. 10] THURSDAY, JUNE 11, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved

LONDON INTERNATIONAL EXHIBITION

AND ROYAL ALBERT HALL, SOUTH KENSINGTON, 1874

OPEN DAILY, 10 a.m. to 6 p.m.

MILITARY BAND

At Three every THURSDAY and SATURDAY.

PERFORMANCE on the GRAND ORGAN

By Mr. WILLIAM CARTER, DAILY at 4.

EXHIBITION OF WINE

(Tasting permitted)

OPEN DAILY, Twelve to Five. Season Ticket holders admitted WITHOUT EXTRA CHARGE. Other Visitors will be charged 6d. extra to the Cellars

REDUCED PRICES of ADMISSION to Artizans at 6d each and to School Children at 3d. each, by purchase of Packets of FIFTY TICKETS, in view of Promoting Technical Instruction

SCHOOL OF COOKERY.

LECTURE (with Practical Illustrations) by Mr BUCKMASTER, every SATURDAY at Three

GRAND OPERA CONCERT

On SATURDAY, June 20, at Three.

ADMISSION to the EXHIBITION and ALBERT HALL, 1s Daily. (Wednesdays, 2s 6d)

THE SCIENTIFIC CLUB.

The SCIENTIFIC CLUB having REMOVED from the WESTMINSTER PALACE HOTEL to their CLUB HOUSE, all Communications should be addressed—

The Secretary,
Scientific Club,
7, Savile, Row Piccadilly, W.

YORKSHIRE COLLEGE OF SCIENCE.

President—LORD F. C. CAVENDISH, M.P.

The Council are prepared to appoint the following Professors, in view of the opening of the College at Leeds, in temporary premises, on October 1st.—

1. A PROFESSOR of CHEMISTRY, also having charge of the Chemical Laboratory. Stipend £300 per annum and two-thirds of the fees of the Lecture Students (excepting registered students of the Leeds School of Medicine), and one-third of the Laboratory fees of all students entering the Laboratory Course

2. A PROFESSOR of GEOLOGY, giving special attention to Coal-mining Stipend £300 per annum, and two-thirds of the fees

3. A PROFESSOR of MATHEMATICS and PHYSICS. Stipend £300 per annum, and two-thirds of the fees

Application must be forwarded not later than July 1, to the Honorary Secretaries, 16, St Andrew's Chambers, Leeds, who will give any further information.

HENRY H SALES, } Honorary
RICHARD REYNOLDS, } Secretaries

June 1st, 1874.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F R S.; Dr Frankland, F.R S; Dr Roscoe, F R S; Dr. Angus Smith, F.R.S, Dr. Tyndall, F R.S, Dr Voelcker, F R S.; Dr Williamson, F R.S.

C. WILLMORE, Principal.

VICTORIA (PHILOSOPHICAL) INSTITUTE

—The ANNUAL MEETING will be held at 8 o'clock on MONDAY, June 15 at the HOUSE of the SOCIETY of ARTS, John Street, Adelphi, when the Address will be delivered.

F. PETRIE, Hon Sec

House of the Institute, 8, Adelphi Terrace
(near Charing Cross)

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

AGRICULTURAL EDUCATION.

An Examination for Ten Scholarships of the value of £20 each for proficiency in the principles of Agriculture, Land Surveying and Mechanics, and Chemistry applied to Agriculture will be held in the month of NOVEMBER next Pupils of schools belonging to the Middle Class Schools Corporation, and of such other schools as may be approved by the Council of the Society, will be eligible to compete

Further information may be obtained on application to

H M. JENKINS, Secretary.

12, Hanover Square, London, W, June 10.

UNIVERSITY COLLEGE, TORONTO.—Applications will be received up to August 15th from Candidates for the PROFESSORSHIP of NATURAL HISTORY in this College. The initial salary is £550 currency per annum, rising to £700 currency by additions of £50 currency at intervals of five years. The applications, with testimonials (originals or certified copies) are to be addressed to the Hon. ARCHIBALD MCKELLAR, Provincial Secretary, Toronto, Ontario, in envelopes marked "Natural History," and should be posted so as to reach him on or before August 15.

The Academic Year of the College will begin on October 1st, and Lectures will begin on October 5th.

JOHN McCAUL, LL.D., President.

University College, Toronto, May 22nd, 1874.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

THE MIDDLESEX HOSPITAL.—Mr. MORRIS, M.A. M.B. F.R.C.S., will give a Course of Instruction in OPERATIVE SURGERY during the present and ensuing months, adapted for the Army, Navy, and Indian Services, and for the Fellowship of the College of Surgeons. Fee, including expenses, £5 5s.

SCIENTIFIC BOOKS.—A few copies can still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Conchólorum, Tankerville Cat., &c., &c., as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c. &c. SOWERBY, 167A, Strand.

PRIVATE TUITION.—A Clergyman, of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS. Home comforts combined with great educational advantages. The highest references.—M.A., care of Editor of NATURE, 29, Bedford Street, Strand, W.C.

SCIENCE TUITION by CORRESPONDENCE.—For Terms, apply to D.C.L., care of Macmillan & Co., 29, Bedford Street, Strand, London, W.C.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

NATURAL SCIENCE MASTERSHIP WANTED after July 31 next by a Graduate of Cambridge, in a first-rate Grammar School. The highest testimonials.—Address, M.A., care of NATURE, 29, Bedford Street, Covent Garden, London, W.C.

A YOUNG LADY seeks a RE-ENGAGEMENT as GOVERNESS in London. She is capable of teaching the rudiments of NATURAL SCIENCE, and has a thorough knowledge of French, German, and the usual branches of a sound English Education.—Address, Miss K., NATURE Office, 29, Bedford Street, Strand, W.C.

REQUIRED, a MATHEMATICAL and NATURAL SCIENCE MASTERSHIP in a good School, by a CAMBRIDGE HONOUR-MAN.—Address—Alpha, care of the Publishers of NATURE, 29, Bedford Street, Strand, W.C.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X.Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS. Must all be well authenticated.—Apply, stating terms, to E. E. B., care of Messrs MACMILLAN and Co., Bedford Street, Strand, W.C.

To LECTURERS and OTHERS.—For Sale, a Browning's AUTOMATIC ELECTRIC LAMP, with battery, large parabolic reflector, carbons and wires complete. All new. Suitable for spectrum experiments. Apply to V. E. A., 120, Falkner Street, Liverpool.

TO NATURALISTS and GEOLOGISTS.—Collections of the beautiful Fossils from a lately-made Cutting near Orford Castle, Suffolk (see Advertisement in NATURE, May 14th), are now being forwarded to the Subscribers. Lists of the Fossils, with other particulars, can now be had by addressing (with stamped envelope) Fredc. Collingwood, Esq., F.G.S., 4, St. Martin's Place, Trafalgar Square. A secure postal-box, with specimens from the Orford Castle Cutting, of Nassa granulata, Trophon muricatum, Tectura virginea, and Emarginula fissura, will be forwarded on receipt of twelve postage-stamps.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

JAMES WOOLLEY, SONS, & CO.,

69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,

For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS

For the various Public Examinations.

Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 „ ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

Now ready,

NEGRETTI & ZAMBRA'S
NEW ENCYCLOPÆDIC CATALOGUE

Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard

METEOROLOGICAL INSTRUMENTS,

Containing very numerous Comparative Tables of Reference, and Illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s. 6d.

NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,
HOLBORN VIADUCT,
45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of
ACHROMATIC MICROSCOPES,
and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals.
Monocular, £5, Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/16 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14s., 4½ in., 17s., 6 in., in Wooden Case, 10s., including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c., and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

- The Flower Garden.
- Landscape Gardening.
- The Fruit Garden.
- Garden Structures.
- Room and Window Gardens.
- Notes and Questions.
- Market Gardening.
- Trees and Shrubs.
- Hardy Flowers.
- Town Gardens.
- The Conservatory.
- Public Gardens.
- The Greenhouse and Stove.
- The Household.
- The Wild Garden.
- The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.— JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.— Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

ROYAL GEOGRAPHICAL SOCIETY.

The ANNIVERSARY MEETING will be held (by permission of the Chancellor and Senate) in the Hall of the University of London, Burlington Gardens, on MONDAY, June 22nd, at 1 p.m. Right Honourable Sir H. BARTLE FRERE, K.C.B., President, in the chair.

The DINNER will take place at Willis's Rooms at half-past 6 on the same day. Right Honourable Sir H. BARTLE FRERE, K.C.B., in the chair.

Dinner Charge, Twenty-three Shillings, payable at the door; or Tickets to be had and Places taken at 1, Savile Row, Burlington Gardens.

The Friends of Members are admissible to the Dinner.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL
AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

A FEW ARTIST'S PROOFS

OF

THE PORTRAIT OF CHARLES DARWIN, F.R.S.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,

PRICE 5s. EACH,

OR THROUGH ANY BOOKSELLER.

NEARLY READY.

TELEGRAPH AND TRAVEL.

A NARRATIVE of the FORMATION and DEVELOPMENT of TELEGRAPHIC COMMUNICATION between ENGLAND and INDIA, under the Orders of Her Majesty's Government, with incidental Notices of the Countries through which the Lines pass.

By COLONEL SIR FREDERIC GOLDSMID, C.B., K.C.S.I.,

Late Director of the Government Indo-European Telegraph.

With numerous Illustrations and Maps. 8vo.

MACMILLAN & CO., LONDON.

Eighth Thousand, cloth, 21s., 70 Plates, 4 Coloured.

HOW TO WORK WITH THE MICROSCOPE. A complete Manual of Microscopical Manipulation. A full description of many new processes of investigation, taking photographs, &c.

HARRISON, Pall Mall.

BY DR. LIONEL BEALE, F.R.S.

1. **PROTOPLASM.—I. Dissentient. II. Demonstrative.** III. Speculative. 3rd Edition, 16 Coloured Plates, 10s. 6d. [*Now ready.*

2. **BIOPLASM, or Living Matter. 22 Plates.** 6s. 6d.

London: J. & A. CHURCHILL.
Philadelphia: LINDSAY & BLAKISTON.

LIGHT SCIENCE for LEISURE HOURS, by R. A. PROCTOR, B.A. Two Series of Essays:—

First Series, including the Aurora, Storms, Magnetism, Betting on Races, &c., 7s. 6d.

Second Series, including Life of Mary Somerville, Gulf Stream, Climate of Britain, &c., 7s. 6d.

London: LONGMANS, GREEN, & CO., Paternoster Row.

In royal 8vo, cloth extra gilt, price 31s. 6d.

CONTRIBUTIONS to SOLAR PHYSICS. By J. NORMAN LOCKYER, F.R.S. I. A Popular Account of Inquiries into the Physical Constitution of the Sun, with especial reference to Recent Spectroscopic Researches. II. Communications to the Royal Society of London and the French Academy of Sciences, with Notes. Illustrated by 7 Coloured Lithographic Plates and 175 Woodcuts.

"The first part of the work, presenting the reader with a continuous sketch of the history of the various inquiries into the physical constitution of the sun, cannot fail to be of interest to all who care for the revolutions of modern science; and the interest will be enhanced by the excellence of the numerous illustrations by which it is accompanied."—*Athenæum.*

"The book may be taken as an authentic exposition of the present state of science in connexion with the important subject of spectroscopic analysis. . . . Even the unscientific public may derive much information from it."—*Daily News.*

London: MACMILLAN & CO.

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

NEW ELECTRICAL ANEMOMETER.

NO SHAFT REQUIRED.

INVENTED BY

J. E. H. GORDON, CAIUS COLLEGE, CAMBRIDGE.

Mr. APPS is now prepared to supply these Instruments complete with wires and six-celled battery at the following prices:—

No. I. to indicate direction on an 8-in. dial, £30.

No. II. to indicate direction and velocity on dials, £50.

No. IV. to indicate direction, and print direction and velocity, £100.

In these instruments the communication between the vane and dial is made by 3 or 4 insulated wires.

The battery has to be recharged once in 5 months (about).

The paper can be cut off as soon as desired, but the reels only require refilling once a in months.

The registering instrument can be placed at any distance from the fans or cups.

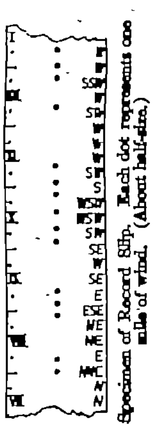
The clock of the recording instrument being fitted with a dial, there is no necessity for a timepiece for general purposes.

This instrument is now to be seen at work in connection with the Society of Arts' Testing Rooms, International Exhibition, South Kensington; and a

No. IV. Anemometer may now be seen in action at

A. APPS,

433, STRAND, LONDON, W.C.



Specimen of Record Slip. Each dot represents one mile of wind. (About half-size.)

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the Instrument to work on	£12 0 0
Reflectors for projecting the Figures on the Screen	2 12 6
N.B.—Specimen Curves, on card, post free ... per dozen...	0 3 0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 9...	0 7 6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0 3 6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5 5 0

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.,

(Three minutes' walk from South Kensington Museum).

DIARY OF SOCIETIES.

London

THURSDAY, June 11.

Royal Society, at 8.30—Spectroscopic Notes, 1, 2, 3, 4, On the Absorption of great Thicknesses of Metallic and Metalloidal Vapours; On a New Class of Absorption Phenomena, &c: J. Norman Lockyer, F.R.S—Note on the Absorption Spectra of Potassium and Sodium at Low Temperatures. Prof Roscoe, F R S, and A. Schuster—Note on the Alleged Existence of Remains of a Lemming in Cave-deposits of England: Prof. Owen, F.R S.—On the Alleged Expansion in Volume of various Substances in passing by Refrigeration from the State of Liquid Fusion to that of Solidification: R. Mallet, F.R.S—Note on the Excitation of the Surface of the Cerebral Hemispheres by Induced Currents: Prof. Sanderson, F.R.S.

Society of Antiquaries, at 8.30—Letters of Lady Rachel Russell and others: R Almack.—Contents of a Cist at Brougham, Westmoreland. Prof. Harkness.

Mathematical Society, at 8.—Parallels of Developables and of Curves of Double Curvature: S. Roberts.—A remarkable relation between the difference of two Fagnanian Arcs of an Ellipse of Eccentricity e and that of two corresponding Arcs of a Hyperbola of Eccentricity $\frac{1}{e}$: J Griffiths.—Note on the Numerical Calculation of the Roots of Fluctuating Functions: Lord Rayleigh, F R S.—Stability of a Dynamical System with two Independent Motions. On Rocking Stones; and Small Oscillations to any Degree of Approximation: E. J. Routh, F.R.S.

FRIDAY, June 12.

Junior Philosophical Society, at 8—The Universal Ether and its Relation to the Undulatory Theory of Light: J. E. Prideaux.

SATURDAY, June 13.

Geologists' Association.—Excursion to Tilburston and Nutfield.

MONDAY, June 15.

Geographical Society, at 8 30.
Victoria Institute, at 8.—Anniversary.

TUESDAY, June 16.

Zoological Society, at 8.30—On the Nature of the Sacs vomited by the Hornbills: Dr J. Murie.—A further Communication upon certain Gigantic Cephalopods recently encountered off the Coast of Newfoundland: W. Saville Kent.—On the "Showing off" of the Australian Bustard (*Eupodotis australis*): A. H Garrod

Statistical Society, at 7 45.—Local Government among different Nations: Sir Charles W. Dilke, Bart.—The Co-operative Land Movement: E. W. Brabrook, F.S.A.

Horticultural Society.—Meeting of Council.

WEDNESDAY, June 17.

Horticultural Society.—Fruit and Floral Meeting.

Meteorological Society, at 7.—On the connection between Colliery Explosions and Weather in 1872: R H. Scott, F.R.S, and W. Galloway.—Solar Radiation, 1869-74. Rev. Fenwick W Stow.—The diurnal inequalities of the Barometer and Thermometer as illustrated by the observations made at the Summit and Base of Mount Washington, U.S, during the Month of May 1872: W. W. Rundell.—On the diurnal variation of the Barometer at Zi-Ka-Wei, and mean Atmospheric Pressure and Temperature at Shanghai: Rev A. M Colombel—Weather Report for 1873 at Woosung, China: Charles D Braysher.—At 9—A Special General Meeting will be held, to consider a revised form of the Bye-Laws proposed by the Council.

THURSDAY, June 18.

Chemical Society, at 8.—On Isodinaphthyl. W. Smith—Communications from the Laboratory of the London Institution: Dr Armstrong—On the Products of the Decomposition of Castor Oil. No. III. On the Decomposition by excess of Alkaline Hydrate. E Nelson—On the Restitution of Burnt Steel. J. L. Davies.—On Hydrogen Persulphide. W Ramsey.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in Nature of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of Nature *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

Office—29, BEDFORD STREET, STRAND.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

COCOA

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided, a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
,, Double ,, 31s. 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

HOLLOWAY'S PILLS.—Medicine for the Spring.—Diseases latent in the system throughout the winter will manifest themselves on the approach of warmer weather, unless the blood be freed from impurities and the body generally from noxious matters. Holloway's Pills have long since established the highest reputation for the full and efficient manner in which they accomplish this purifying purpose. These excellent Pills search every organ, pervade every tissue, and successfully grapple with all deleterious substances, either by neutralising them or expelling them. Holloway's medicine promotes comfort, cheerfulness, health, and strength. The medicine is admirably adapted for the weak and delicate, whose frames are relaxed, whose nerves are unstrung, and whose digestions are upset alike by spring variations and summer's heat.

"NATURE."

Nearly all the Back Numbers of Nature may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to Advertisements should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10s. 6d.

Cloth Cases for binding all the volumes, price 1s. 6d. each.

Reading Cases to hold 26 numbers, price 2s. 6d.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. Nature Office, 29, Bedford Street, Strand, W.C.

WORKS IN PHYSICAL SCIENCE.

Oliver.—Works by Daniel Oliver, F.R.S. F.L.S., Professor of Botany in University College, London, and Keeper of the Herbarium and Library of the Royal Gardens, Kew :—

LESSONS IN ELEMENTARY BOTANY. With nearly Two Hundred Illustrations. New Edition, 18mo, cloth, 4*s*. 6*d*.

This book is designed to teach the elements of Botany on Prof. Henslow's plan of selected Types and by the use of Schedules. The earlier chapters, embracing the elements of Structural and Physical Botany, introduces us to the methodical study of the Ordinal Types. The concluding chapters are entitled, "How to Dry Plants" and "How to Describe Plants." A valuable Glossary is appended to the volume. In the preparation of this work free use has been made of the manuscript materials of the late Prof. Henslow.

FIRST BOOK OF INDIAN BOTANY. With numerous Illustrations. Extra fcap. 8vo, 6*s*. 6*d*.

This manual is, in substance, the author's "Lessons in Elementary Botany," adapted for use in India. In preparing it he has had in view the want, often felt, of some handy *résumé* of Indian Botany, which might be serviceable not only to residents of India, but also to anyone about to proceed thither, desirous of getting some preliminary idea of the botany of the country. "It contains a well-digested summary of all essential knowledge pertaining to Indian botany, wrought out in accordance with the best principles of scientific arrangement."—*Allen's Indian Mail.*

Penrose (F. C.)—On a METHOD of PREDICTING by GRAPHICAL CONSTRUCTION, OCCULTATIONS of STARS by the MOON, and SOLAR ECLIPSES for any GIVEN PLACE. Together with more rigorous methods for the Accurate Calculation of Longitude. By F. C. PENROSE, F.R.A.S. With Charts, Tables, &c., 4to, 12*s*.

The author believes that if, by a graphic method, the prediction of occultations can be rendered more inviting, as well as more expeditious, than by the method of calculation, it may prove acceptable to the nautical profession as well as to scientific travellers or amateurs. The author has endeavoured to make the whole process as intelligible as possible, so that the beginner, instead of merely having to follow directions imperfectly understood, may readily comprehend the meaning of each step, and be able to illustrate the practice by the theory. Besides all necessary charts and tables, the work contains a large number of skeleton forms for working out cases in practice.

Roscoe.—Works by Henry E. Roscoe, F.R.S. Professor of Chemistry in Owens College, Manchester :—

LESSONS IN ELEMENTARY CHEMISTRY, INORGANIC AND ORGANIC. With numerous Illustrations and Chromolithos of the Solar Spectrum, and of the Alkalies and Alkaline Earths. New Edition, 18mo, cloth, 4*s*. 6*d*.

It has been the endeavour of the author to arrange the most important facts and principles of modern chemistry in a plain but concise and scientific form, suited to the present requirements of elementary instruction. For the purpose of facilitating the attainment of exactitude in the knowledge of the subject, a series of exercises and questions upon the lessons has been added. The metric system of weights and measures, and the centigrade thermometric scale, are used throughout this work. The new edition, besides new woodcuts, contains many additions and improvements, and includes the most important of the latest discoveries. "We unhesitatingly pronounce it the best of all our elementary treatises on Chemistry."—*Medical Times.*

Roscoe—(Continued).

SPECTRUM ANALYSIS. Six Lectures, with Appendices, Engravings, Maps, and Chromolithographs. Royal 8vo, 21*s*.

A Third Edition of these popular Lectures, containing all the most recent discoveries and several additional illustrations. "In six lectures he has given the history of the discovery and set forth the facts relating to the analysis of light in such a way that any reader of ordinary intelligence and information will be able to understand what 'Spectrum Analysis' is, and what are its claims to rank amongst the most signal triumphs of Science."—*Nonconformist.*

Stewart (B.)—LESSONS in ELEMENTARY PHYSICS. By BALFOUR STEWART, F.R.S. Professor of Natural Philosophy in Owens College, Manchester. With numerous Illustrations and Chromoliths of the Spectra of the Sun, Stars, and Nebulæ. New Edition, 18mo, 4*s*. 6*d*.

A description, in an elementary manner, of the most important of those laws which regulate the phenomena of nature. The active agents, heat, light, electricity, &c., are regarded as varieties of energy, and the work is so arranged that their relation to one another, looked at in this light, and the paramount importance of the laws of energy, are clearly brought out. The volume contains all the necessary illustrations. The *Educational Times* calls this "the beau-ideal of a scientific text-book, clear, accurate, and thorough."

Thomson.—The DEPTHS of the SEA: an Account of the General Results of the Dredging Cruises of H.M.SS. *Porcupine* and *Lightning* during the Summers of 1868–69–70, under the scientific direction of Dr. Carpenter, F.R.S., J. Gwyn Jeffreys, F.R.S., and Dr. Wyville Thomson, F.R.S. By Dr. WYVILLE THOMSON, Director of the Scientific Staff of the *Challenger* Expedition. With nearly 100 Illustrations and 8 Coloured Maps and Plans. 8vo, cloth, gilt, 31*s*. 6*d*.

It was the results recorded in this volume that induced the Government to send out the great Expedition now launched under the scientific guidance of Dr. Wyville Thomson, which is spoken of as "the most important surveying expedition which has ever sailed from any country."

Thornton.—OLD-FASHIONED ETHICS, and COMMON-SENSE METAPHYSICS, with some of their Applications. By WILLIAM THOMAS THORNTON, Author of "A Treatise on Labour." 8vo, 10*s*. 6*d*.

The following are the contents of the volume :—I. Ante-Utilitarianism. II. History's Scientific Pretensions. III. David Hume as a Metaphysician. IV. Huxleyism. V. Recent Phases of Scientific Atheism. VI. Limits of Demonstrable Atheism.

Thudichum and Dupre.—A TREATISE on the ORIGIN, NATURE, and VARIETIES of WINE. Being a Complete Manual of Viticulture and Œnology. By J. L. THUDICHUM, M.D., and AUGUST DUPRÉ, Ph.D., Lecturer on Chemistry at Westminster Hospital. Medium 8vo, cloth gilt, 25*s*. With 85 Illustrative Woodcuts.

"A treatise almost unique for its usefulness either to the wine-grower, the vendor, or the consumer of wine. The analyses of wine are the most complete we have yet seen, exhibiting at a glance the constituent principles of nearly all the wines known in this country."—*Wine Trade Review.*

MACMILLAN & CO., LONDON.

WORKS IN PHYSICAL SCIENCE.

Kirchhoff (G.)—RESEARCHES on the SOLAR SPECTRUM, and the Spectra of the Chemical Elements. By G. KIRCHHOFF, Professor of Physics in the University of Heidelberg. Second Part. Translated, with the Author's sanction, from the Transactions of the Berlin Academy for 1862, by HENRY R. ROSCOE, B.A. Ph.D. F.R.S., Professor of Chemistry in Owen's College, Manchester. Part II. 4to, 5*s*.

"It is to Kirchhoff we are indebted for by far the best and most accurate observations of these phenomena."—*Edin. Review.* "This memoir seems almost indispensable to every spectrum observer."—*Philosophical Magazine.*

Lockyer (J. N.)—ELEMENTARY LESSONS in ASTRONOMY. With numerous Illustrations. By J. NORMAN LOCKYER, F.R.S. New Edition. 18mo, 5*s*. 6*d*.

The author has here aimed to give a connected view of the whole subject, and to supply facts, and ideas founded on the facts, to serve as a basis for subsequent study and discussion. The chapters treat of the Stars and Nebulæ; the Sun, the Solar System; the Apparent Movements of the Heavenly Bodies; the Measurement of Time; Light; the Telescope and Spectroscope; Apparent Places of the Heavenly Bodies; the Real Distances and Dimensions; Universal Gravitation. The most recent Astronomical Discoveries are incorporated. "The book is full, clear, sound, and worthy of attention, not only as a popular exposition, but as a scientific 'Index.'"—*Athenæum.* "The most fascinating of elementary books on the Sciences."—*Nonconformist.*

Macmillan (Rev. Hugh).—HOLIDAYS ON HIGH LANDS; or, Rambles and Incidents in search of Alpine Plants. Crown 8vo, cloth, 6*s*.

The aim of this book is to impart a general idea of the origin, character, and distribution of those rare and beautiful Alpine plants which occur on the British hills, and which are found almost everywhere on the lofty mountain chains of Europe, Asia, Africa, and America. In the first three chapters the peculiar vegetation of the Highland mountains is fully described; while in the remaining chapters this vegetation is traced to its northern cradle in the mountains of Norway, and to its southern European termination in the Alps of Switzerland. The information the author has to give is conveyed in a setting of personal adventure. "One of the most charming books of its kind ever written."—*Literary Churchman.* "Mr. M.'s glowing pictures of Scandinavian scenery."—*Saturday Review.*

FOOT-NOTES FROM THE PAGE OF NATURE. With numerous Illustrations. Fcap. 8vo, 5*s*.

"The naturalist and the botanist will delight in this volume, and those who understand little of the scientific parts of the work will linger over the mysterious page of nature here unfolded to their view."—*John Bull.*

Mansfield (C. B.)—A THEORY of SALTS. A Treatise on the Constitution of Bipolar (two-membered) Chemical Compounds. By the late CHARLES BLACKFORD MANSFIELD. Crown 8vo, 14*s*.

"Mansfield," says the editor, "wrote this book to defend the principle that the fact of voltaic decomposition afforded the true indication, if properly interpreted, of the nature of the saline structure, and of the atomicity of the elements that built it up. No chemist will peruse this book without feeling that he is in the presence of an original thinker, whose pages are continually suggestive, even though their general argument may not be entirely concurrent in direction with that of modern chemical thought."

Mivart (St. George).—Works by St. George Mivart, F.R.S., &c., Lecturer on Comparative Anatomy at St. Mary's Hospital:—

ON THE GENESIS OF SPECIES. Crown 8vo. Second Edition, to which notes have been added in reference and reply to Darwin's "Descent of Man." With numerous Illustrations, pp. xv. 296, 9*s*.

The aim of the author is to support the doctrine that the various species have been evolved by ordinary natural laws (for the most part unknown) controlled by the subordinate action of "natural selection," and at the same time to remind some that there is and can be absolutely nothing in physical science which forbids them to regard those natural laws as acting with the Divine concurrence, and in obedience to a creative fiat originally imposed on the primeval cosmos, "in the beginning," by its Creator, its Upholder, and its Lord. Nearly fifty woodcuts illustrate the letter-press, and a complete index makes all references extremely easy. Canon Kingsley, in his address to the "Devonshire Association," says, "Let me recommend earnestly to you, as a specimen of what can be said on the other side, the 'Genesis of Species,' by Mr. St. George Mivart, F.R.S., a book which I am happy to say has been received elsewhere as it has deserved, and, I trust, will be received so among you."

LESSONS IN ELEMENTARY ANATOMY. With upwards of 400 Illustrations, 18mo, 6*s*. 6*d*.

This volume is intended to form one of the series of Elementary Class-books of Science, and the Lessons are intended in the first place for teachers and for earnest students of both sexes, not already acquainted with human anatomy. The author has endeavoured, secondly, by certain additions and by the mode of treatment, to fit them for students in medicine, and generally for those acquainted with human anatomy, but desirous of learning its more significant relations to the structure of other animals: the author therefore hopes his volume may serve as a handbook of Human Morphology. The book is amply illustrated with carefully-drawn woodcuts.

Murphy.—Works by Joseph John Murphy:—

HABIT AND INTELLIGENCE, in Connection with the Laws of Matter and Force: a Series of Scientific Essays. Two Vols. 8vo. 16*s*.

The author's chief purpose in this work has been to state and to discuss what he regards as the special and characteristic principles of life. The most important part of the work treats of those vital principles which belong to the inner domain of life itself, as distinguished from the principles which belong to the border-land where life comes into contact with inorganic matter and force. In the inner domain of life we find two principles, which are, the author believes, co extensive with life and peculiar to it: these are Habit and Intelligence. He has made as full a statement as possible of the laws under which habits form, disappear, alter under altered circumstances, and vary spontaneously. He discusses that most important of all questions, whether intelligence is an ultimate fact, incapable of being resolved into any other, or only a resultant from the laws of habit. The latter part of the first volume is occupied with the discussion of the question of the Origin of Species. The first part of the second volume is occupied with an inquiry into the process of mental growth and development, and the nature of mental intelligence. In the chapter that follows the author discusses the science of history, and the three concluding chapters contain some ideas on the classification, the history, and the logic of the sciences. The author's aim has been to make the subjects treated of intelligible to any ordinary intelligent man.

THE SCIENTIFIC BASES OF FAITH. 8vo, 14*s*.

MACMILLAN & CO., LONDON.

E. DENT & CO., 61, Strand, & 34, Royal Exchange.
(FACTORY, SAVOY ST.), LONDON.

MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), **COMPASSES, &c.,**
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.

MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.

MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.

Catalogues or Estimates on Application.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr. Lankester, September 10, 1867; Dr. Letheby, February 15, 1865, and December 1872.

Price £1 10s and upwards. Portable Filters on this system, £1 5s to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham, by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s. each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters, from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2d.

IN THE PRESS.

ISMAILÏA

A NARRATIVE OF
THE EXPEDITION TO CENTRAL AFRICA
FOR THE SUPPRESSION OF
THE SLAVE TRADE.
ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.
By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,

Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.

MACMILLAN & CO., LONDON.

THIS DAY, in 8vo, price 14s.

ESSAYS AND ADDRESSES.
BY
PROFESSORS & LECTURERS OF OWENS COLLEGE, MANCHESTER.
Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873.

CONTENTS.

OPENING ADDRESS. By the Duke of Devonshire, K.G. F.R.S., President of the Court of Governors.

"On some Relations of Culture to Practical Life." By J. G. Greenwood, Principal and Professor of Greek.

"Original Research as a Means of Education." By H. E. Roscoe, F.R.S., Professor of Chemistry.

"Solar Physics." By Balfour Stewart, F.R.S., Professor of Natural Philosophy.

"The Sun's Distance from the Earth." By T. H. Core, Professor of Natural Philosophy.

"The Limits of Geological Knowledge." By W. Boyd Dawkins, F.R.S., Curator of the Natural History Museum, and Lecturer in Geology and Palæontology.

"The Use of Steam." By Osborne Reynolds, Professor of Engineering.

"Primeval Vegetation in its Relation to the Doctrines of Natural Selection and Evolution." By W. C. Williamson, F.R.S., Professor of Natural History.

"Science and Medicine." By A. Gamgee, F.R.S., Professor of Practical Physiology and Histology.

"Some Historical Results of the Science of Language." By A. S. Wilkins, Professor of Latin and Comparative Philology.

"The Talmud." By T. Theodores, Professor of Oriental and Modern Languages.

"Provencal Poetry in Old and Modern Times." By H. Breymann, Lecturer on French Language and Literature.

"The Recent Reorganisation of the English Law Courts, in its Relation to their Past History." By J. Bryce, D.C.L., Professor of Jurisprudence and Law.

"The Railways and the State." By W. Stanley Jevons, F.R.S., Professor of Logic, and Mental and Moral Philosophy, and Political Economy.

"The Peace of Europe." By A. W. Ward, Professor of English and History.

MACMILLAN & CO., LONDON.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, June 11, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 242, Vol. 10] THURSDAY, JUNE 18, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office. [All Rights are Reserved

ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN AND IRELAND,

4, St. Martin's Place, Trafalgar Square, W.C.

(In which are united the Anthropological Society of London and the Ethnological Society of London)

President ... ... Prof. Busk, F R S.
Treasurer ... ... Rev Dunbar I. Heath, M A.
Director ... ... E. W Brabrook, Esq. F.S A.

The Institute will meet on Tuesday, June 23rd, at 8 o'clock p m. precisely, when the following Papers will be read :—

1 —"Ethnic Psychology." By Robert Dunn, Esq. F.R C S.

2 —"Relative Ages of Cremation and contracted Burial in Derbyshire in the Neolithic and Bronze Ages." By Rooke Pennington, Esq. M.A.I.

3 —"Mythological Birds Ethnologically considered." By Miss A. W. Buckland.

J. FRED. COLLINGWOOD, *Secretary.*

PHYSICAL GEOGRAPHY.—The PROFESSORSHIP is now VACANT in the Bedford College (for Ladies), 48 and 49, Bedford Square, London (In October the College will be removed to Nos 8 and 9, York Place, Portman Square) Applications are invited. Information may be obtained from the hon. sec at the College.

JANE MARTINEAU, Hon Sec.

QUEENWOOD COLLEGE, near STOCK BRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus. F.R S ; Dr. Frankland, F.R S ; Dr. Roscoe, F R S ; Dr. Angus Smith, F.R.S. ; Dr. Tyndall, F R.S., Dr. Voelcker, F.R S., Dr Williamson, F R S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof E. V. GARDNER, F.E.S., F.S A., 44, Berners Street, W

SCIENTIFIC BOOKS.—A few copies can still be had of Sowerby's Mineral Conchology, British and Exotic Mineralogy, English Fungi, British Miscellany, Zoological Journal, Genera of Shells, Species Conchologium, Tankerville Cat., &c, &c, as well as a large stock of second-hand books on Geology, Conchology, Entomology, &c &c. SOWERBY, 167A, Strand.

YORKSHIRE COLLEGE OF SCIENCE.

President—LORD F C. CAVENDISH, M.P.

The Council are prepared to appoint the following Professors, in view of the opening of the College at Leeds, in temporary premises, on October 1st :—

1 A PROFESSOR of CHEMISTRY, also having charge of the Chemical Laboratory. Stipend £300 per annum, and two-thirds of the fees of the Lecture Students (excepting registered students of the Leeds School of Medicine), and one-third of the Laboratory fees of all students entering the Laboratory Course.

2. A PROFESSOR of GEOLOGY, giving special attention to Coal-mining. Stipend £300 per annum, and two-thirds of the fees

3 A PROFESSOR of MATHEMATICS and PHYSICS. Stipend £300 per annum, and two-thirds of the fees

Application must be forwarded not later than July 1, to the Honorary Secretaries, 16, St Andrew's Chambers, Leeds, who will give any further information

HENRY H. SALES, } Honorary
RICHARD REYNOLDS, } Secretaries

June 1st, 1874.

ROYAL GEOGRAPHICAL SOCIETY.

The ANNIVERSARY MEETING will be held (by permission of the Chancellor and Senate) in the Hall of the University of London, Burlington Gardens, on MONDAY, June 22nd, at 1 p m. Right Honourable Sir H. Bartle Frere, K C.B, President, in the chair

The DINNER will take place at Willis's Rooms at half-past 6 on the same day. Right Honourable Sir H. Bartle Frere, K C B, in the chair.

Dinner Charge, Twenty-three Shillings, payable at the door, or Tickets to be had and Places taken at 1, Savile Row, Burlington Gardens.

The Friends of Members are admissible to the Dinner

THE SCIENTIFIC CLUB.

The SCIENTIFIC CLUB having REMOVED from the WESTMINSTER PALACE HOTEL to their CLUB HOUSE. Applications for Memberships and other Communications should be addressed—

The Secretary,
Scientific Club,
7, Savile Row, Piccadilly, W.

NATURAL SCIENCE MASTERSHIP WANTED after July 31 next by a Graduate of Cambridge, in a first-rate Grammar School. The highest testimonials —Address, M A, care of Nature, 29, Bedford Street, Covent Garden, London, W C.

PRIVATE TUITION.—A Clergyman, of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS. Home comforts combined with great educational advantages. The highest references.—M A., care of Editor of NATURE, 29, Bedford Street, Strand, W.C.

SCIENCE TUITION by CORRESPONDENCE.—For Terms, apply to D.C.L., care of Macmillan & Co., 29, Bedford Street, Strand, London, W.C.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W C.

A YOUNG LADY seeks a RE-ENGAGEMENT as GOVERNESS in London. She is capable of teaching the rudiments of NATURAL SCIENCE, and has a thorough knowledge of French, German, and the usual branches of a sound English Education. Address, Miss K., NATURE Office, 29, Bedford Street, Strand, W C.

SCIENCE TUITION by CORRESPONDENCE—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope.—For terms, &c., address H., care of Macmillan and Co., 29, Bedford Street, Strand, London, W.C.

MICROSCOPE by Smith and Beck for Sale, with sub-stage, three eye-pieces, best objectives, and a quantity of expensive accessories. The whole in Mahogany Cabinet, and cost £50 To be sold for £28. Apply by letter to R. B., care of Macmillan & Co. 29, Bedford Street, Covent Garden, W.C.

TO NATURALISTS and GEOLOGISTS.—Fossils from the Cutting in the Crag near Orford Castle (see Advertisement in NATURE, May 14th). Twenty Collections each of Fifty Species have now been delivered to subscribers Each species is sent in a glass-capped box with a printed label in the following style:—

Nassa granulata
Red Crag, near Orford Castle.

Trophon alveolatum
Coralline Crag, near Orford Castle.

Particulars may now be had by addressing (with stamped envelope) Fredc. Collingwood, Esq. F.G.S. 4, St. Martin's Place, Trafalgar Square. On receipt of twelve stamps, 4 choice specimens from the Orford Castle Cutting of Nassa granulata, 3 of Trophon muricatum, 2 of Tectura virginea, and 1 of Emarginula fissura, will be forwarded in a secure postal-box.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints, and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 22, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 10s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

THE JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations. Conducted by J W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s each; the succeeding vols. may be had separately or together at 7s. each.

London. JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS:—W. BEST & SONS, Henrietta Street, Cavendish Square.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,
Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests.

Subscription, 16s. 6d. per annum, post free, dating from any quarter-day. Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus,

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

THOMAS D. RUSSELL, GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 "	One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

Now ready,

NEGRETTI & ZAMBRA'S NEW ENCYCLOPÆDIC CATALOGUE

Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard

METEOROLOGICAL INSTRUMENTS,

Containing very numerous Comparative Tables of Reference, and illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s. 6d.

NEGRETTI AND ZAMBRA,
SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,
HOLBORN VIADUCT,
45 Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

POPULAR ASTRONOMY. By G. B. AIRY, Astronomer Royal. With Illustrations. Sixth and Cheaper Edition. 18mo, cloth, 4s. 6d.

"Popular Astronomy in general has many manuals, but none of them supersede the Six Lectures of the Astronomer Royal under that title. Its speciality is the direct way in which every step is referred to the observatory, and in which the methods and instruments by which every observation is made are fully described. This gives a sense of solidity and substance to astronomical statements which is obtainable in no other way."—*Guardian.*

MACMILLAN & CO., LONDON

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

This day is published.

MANUAL OF BOTANY,

ANATOMICAL AND PHYSIOLOGICAL.

FOR THE USE OF STUDENTS.

By ROBERT BROWN, M.A., Ph.D., F.L.S., F.R.G.S., &c.

Lecturer on Botany, Edinburgh.

360 Illustrations. Crown 8vo, 12*s.* 6*d.*

WILLIAM BLACKWOOD & SONS, Edinburgh and London.

A FEW ARTIST'S PROOFS

OF

THE PORTRAIT OF CHARLES DARWIN, F.R.S.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,

PRICE 5s. EACH,

OR THROUGH ANY BOOKSELLER.

NEARLY READY.

TELEGRAPH AND TRAVEL.

A NARRATIVE of the FORMATION and DEVELOPMENT of TELEGRAPHIC COMMUNICATION between ENGLAND and INDIA, under the Orders of Her Majesty's Government, with incidental Notices of the Countries through which the Lines pass.

By COLONEL SIR FREDERIC GOLDSMID, C.B., K.C.S.I.,

Late Director of the Government Indo-European Telegraph.

With numerous Illustrations and Maps. 8vo.

MACMILLAN & CO., LONDON.

ZOOLOGICAL SOCIETY'S LATEST PUBLICATIONS.

"Proceedings of the Scientific Meetings of the Society for 1874."—Part I, containing the Papers read at the Scientific Meetings in January and February, 1874. With 25 Plates, mostly coloured, 12*s.* : with Plates, uncoloured, 3*s.*

Index to the Proceedings of the Zoological Society from 1830 to 1847, from 1848 to 1860, and from 1861 to 1870, in three volumes. Price 6*s.* each volume.

NOTICE.

Commencing from January of the present year the "Proceedings" will be issued in four Parts, as follows :—

Part I., containing Papers read in January and February, on June 1st.
" II., " " March and April, on August 1st.
" III., " " May and June, on October 1st
" IV., " " November and December, on April 1st.

The price will be 12*s.* per Part for the Edition with coloured, and 3*s.* per Part for that with uncoloured Plates.

TRANSACTIONS OF THE SOCIETY.

Vol. VIII., Part 7, price 22*s.* Containing :—

Mr. ST. GEORGE MIVART, F.R.S.—"On the Axial Skeleton of the Ostrich" (*Struthio camelus*). (79 woodcuts.)

Vol. VIII., 8, price 24*s.* Containg the following Papers :—

"On the Osteology and Dentition of *Hylomys*." By JOHN ANDERSON, M.D., Curator of the Indian Museum, and Professor of Comparative Anatomy in the Medical College, Calcutta.

"Report on the Hydroida collected during the Expeditions of H.M.S. *Porcupine*." By Professor G. J. ALLMAN, F.R.S.

"On the Osteology of the *Marsupialia*. (Part IV.) Bones of the trunk and limbs, *Phascolomys*." By Professor OWEN, C.B. F.R.S. F.Z.S.

These publications may be obtained at the Society's Office, 11, Hanover Square, W.; at Messrs. Longmans, the Society's Publishers, Paternoster Row, E.C.; or through any bookseller.

RICHARD CONGREVE'S ESSAYS.

Just published, in 1 vol. 8vo, cloth, price 18*s.*

ESSAYS, POLITICAL, SOCIAL, and RELIGIOUS.

By RICHARD CONGREVE, M.A. M.R.C.P.L., formerly Fellow and Tutor of Wadham College, Oxford.

List of the Essays :—Gibraltar—India—Italy and the Western Powers—The West—Mr. Broadhead and the Anonymous Press—Ireland—The Ashantee War—Mr. Huxley on M. Comte—The New Religion in its Attitude towards the Old—The Propagation of the Religion of Humanity—Le Culte des Morts—Systematic Policy—Education—Moral and Social Questions connected with our Indian Empire—L'Union des Prolétariats Anglais et Français—The Combination of France and England—The Settlement of France—with some minor pieces.

London : LONGMANS, GREEN, & CO., Paternoster Row.

Third Edition, royal 8vo, cloth extra, 21*s.*

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S.

With Appendices, Engravings, Maps, and Chromo-lithographs.

"The illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations."—*Saturday Review.*

"The lectures themselves furnish a most admirable elementary treatise on the subject, whilst by the insertion in appendices to each lecture of extracts from the most important published memoirs, the author has rendered it equally valuable as a text-book for advanced students."—*Westminster Review.*

MACMILLAN & CO., LONDON.

ECLIPSES PAST and FUTURE, with GENERAL HINTS for OBSERVING the HEAVENS.

By Rev. S. J. JOHNSON, F.R.A.S. Part I. An Account of Eclipses from the earliest times to the present, future eclipses, &c. Part II. A Description of Celestial Objects worth observing with a small telescope. 4*s.*

PARKER'S, 377, Strand.

DIARY OF SOCIETIES.

London

THURSDAY, June 18.

Royal Society, at 8 30 —On Coniferine, and its Conversion into the Aromatic Principle of Vanilla: Messrs Tiemann and Haarmann.—Tables of Temperature of the Sea at different Depths beneath the Surface: J. Prestwich, F R.S —Researches on Explosives. Fired Gunpowder. Capt. Noble, F R S, and F A. Abel, F.R S —On the Employment of a Planimeter to obtain Mean Values from the Traces of continually Self-recording Meteorological Instruments: R. H. Scott, F R S.—Description of Living and Extinct Races of gigantic Land Tortoises—Parts I and II ; and other Papers: Dr Gunther, F R S

Society of Antiquaries, at 8 30 —On a Cist at Brougham, Westmoreland: Prof Harkness.—Deeds and Seals of the Greshams and others, G Leveson Gower.

Chemical Society, at 8.—On Isodinaphthyl W. Smith —Communications from the Laboratory of the London Institution: Dr Armstrong —On the Products of the Decomposition of Castor Oil No III. On the Decomposition by excess of Alkaline Hydrate: E Neison —On the Restitution of Burnt Steel: J. L. Davies.—On Hydrogen Persulphide. W Ramsey.

Linnean Society, at 8 —On the Auxemmeæ, a New Tribe of Cordiaceæ: J. Miers —On some Fungi collected by Dr S. Kurz in Yomah, Pegu F Currey.—Notes on the Letters from Danish and Norwegian Naturalists contained in the Linnean Correspondence Prof. Schiodte.—Note on the Pollen of *Pringlea* A. W. Bennett.

FRIDAY, June 19.

Medical Microscopical Society, at 8

MONDAY, June 22

Geologists' Association —Excursion to Hampstead.

TUESDAY, June 23.

Anthropological Institute, at 8 —Ethnic Psychology. Robert Dunn —Relative Ages of Cremation and contracted Burial in Derbyshire in the Neolithic and Bronze Ages Rooke Pennington —Mythological Birds Ethnologically considered: Miss A W. Buckland.

WEDNESDAY, June 24.

Royal Society of Literature, at 8.—The Commerce of Ancient Rome with the East: Mr Vaux.

LONDON INTERNATIONAL EXHIBITION

AND ROYAL ALBERT HALL, SOUTH KENSINGTON, 1874

OPEN DAILY, 10 a m. to 6 p.m.

ADMISSION 1*s*. Wednesdays, 2*s*. 6*d*.

MILITARY BAND

every THURSDAY and SATURDAY at Three, and

PERFORMANCE on the GRAND ORGAN

DAILY (except Monday, the 22nd of June) by Mr. WILLIAM CARTER, at 4.

FOREIGN EXHIBITION OF WINE

CELLARS OPEN FREE to VISITORS to the Exhibition from 1 to 5 30 p m.

JUBILEE MEETING

Of the SOCIETY for PREVENTION of CRUELTY to ANIMALS on MONDAY, 22nd June

JAMES WOOLLEY, SONS, & CO.,

69, MARKET STREET, MANCHESTER.

CHEMICAL APPARATUS AND REAGENTS,

For Lecture and Class Demonstration, Laboratory Instruction, &c.

SETS OF APPARATUS AND CHEMICALS

For the various Public Examinations.

Portable Chemical Cabinets adapted for Private Study.

Price Lists on Application.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern, packed in Deal Cabinet (3 ft. × 1 ft square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

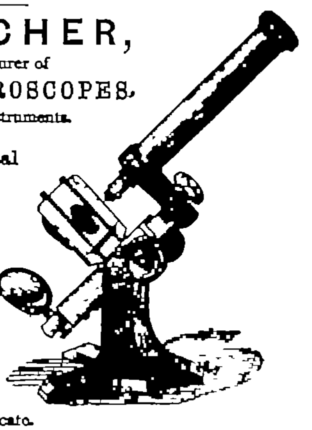
FOR EXCELLENCE AND CHEAPNESS

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.



Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals.
Monocular, £5, Binocular, £10 10*s*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/16 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in, 14*s*., 4½ in, 17*s* ; 6 in, in Wooden Case, 10*s*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

In royal 8vo, cloth extra gilt, price 31*s*. 6*d*.

CONTRIBUTIONS to SOLAR PHYSICS.

By J. NORMAN LOCKYER, F R S. I. A Popular Account of Inquiries into the Physical Constitution of the Sun, with especial reference to Recent Spectroscopic Researches. II Communications to the Royal Society of London and the French Academy of Sciences, with Notes. Illustrated by 7 Coloured Lithographic Plates and 175 Woodcuts

"The first part of the work, presenting the reader with a continuous sketch of the history of the various inquiries into the physical constitution of the sun, cannot fail to be of interest to all who care for the revelations of modern science, and the interest will be enhanced by the excellence of the numerous illustrations by which it is accompanied"—*Athenæum*.

"The book may be taken as an authentic exposition of the present state of science in connexion with the important subject of spectroscopic analysis. . . Even the unscientific public may derive much information from it" —*Daily News*.

London: MACMILLAN & CO.

HOLLOWAY'S OINTMENT and PILLS.

—For the cure of burns, scalds, wounds, and ulcers, this justly celebrated Ointment stands unrivalled Its balsamic virtues immediately on application lull the pain and smarting, protect the exposed nerves from the air, give to the vessels the vigour necessary to heal the sore, and confer on the blood a purity which permits it only to lay down healthy flesh in the place of that destroyed. Holloway's Pills simultaneously taken much assist the Ointment's purifying and soothing power Together, these medicaments act like a charm Travellers embarking for unwholesome climates, where pestilential airs are constantly producing fever, should provide themselves with these remedies, which will assuredly save them nights of weary watching and days of pain.

WORKS IN PHYSICAL SCIENCE.

Wallace (A. R.)—CONTRIBUTIONS to the THEORY of NATURAL SELECTION. A Series of Essays. By ALFRED RUSSEL WALLACE, Author of "The Malay Archipelago," &c. Second Edition, with Corrections and Additions. Crown 8vo. 8*s*. 6*d*.

"He has combined an abundance of fresh and original facts with a liveliness and sagacity of reasoning which are not often displayed so effectively on so small a scale."—*Saturday Review*. The Essays in this volume are:—I. "On the Law which has regulated the introduction of New Species." II. "On the Tendencies of Varieties to depart indefinitely from the Original Type." III. "Mimicry, and other Protective Resemblances among Animals." IV. "The Malayan Papilionidæ, as illustrative of the Theory of Natural Selection." V. "On Instinct in Man and Animals." VI. "The Philosophy of Birds' Nests." VII. "A Theory of Birds' Nests." VIII. "Creation by Law." IX. "The Development of Human Races under the Law of Natural Selection." X. "The Limits of Natural Selection as applied to Man."

Warington.—THE WEEK of CREATION; OR, THE COSMOGONY OF GENESIS CONSIDERED IN ITS RELATION TO MODERN SCIENCE. By GEORGE WARINGTON, Author of "The Historic Character of the Pentateuch Vindicated." Crown 8vo. 4*s*. 6*d*.

The greater part of this work is taken up with the teaching of the Cosmogony. Its purpose is also investigated, and a chapter is devoted to the consideration of the passage in which the difficulties occur. "A very able vindication of the Mosaic Cosmogony, by a writer who unites the advantages of a critical knowledge of the Hebrew text and of distinguished scientific attainments."—*Spectator*.

Wilson.—Works by the late George Wilson, M.D., F.R.S.E., Regius Professor of Technology in the University of Edinburgh:—

RELIGIO CHEMICI. With a Vignette beautifully engraved after a design by Sir Noel Paton. Crown 8vo. 8*s*. 6*d*.

"George Wilson," says the Preface to this volume, "had it in his heart for many years to write a book corresponding to the *Religio Medici* of Sir Thomas Browne, with the title *Religio Chemici*. Several of the Essays in this volume were intended to form chapters of it. These fragments being in most cases like finished gems waiting to be set, some of them are now given in a collected form to his friends and the public. In living remembrance of his purpose, the name chosen by himself has been adopted, although the original design can be but very faintly represented." The Contents of the volume are:—"Chemistry and Natural Theology." "The Chemistry of the Stars; an Argument touching the Stars and their Inhabitants." "Chemical Final Causes; as illustrated by the presence of Phosphorus, Nitrogen, and Iron in the Higher Sentient Organisms." "Robert Boyle." "Wollaston." "Life and Discoveries of Dalton." "Thoughts on the Resurrection; an Address to Medical Students." The *Freeman* says: "These papers are all valuable and deeply interesting. The production of a profound thinker, a suggestive and eloquent writer, and a man whose piety and genius went hand in hand."

THE PROGRESS OF THE TELEGRAPH. Fcap. 8vo. 1*s*.

"While a complete view of the progress of the greatest of human inventions is obtained, all its suggestions are brought out with a rare thoughtfulness, a genial humour, and an exceeding beauty of utterance."—*Nonconformist*.

Wilson (Daniel).—CALIBAN: The MISSING LINK. By DANIEL WILSON, LL.D., Pofessor of History and English Literature in University College, Toronto. 8vo, 10*s*. 6*d*.

In the present state of the controversy as to the origin of man, this work of a competent scholar and critic, in which the Monster Caliban is studied from various points of view, will be of considerable interest. Besides "Caliban," the work treats of various other matters of Shakespearian interest, as "The Supernatural," "Ghosts and Witches," "Fairy Folk-Lore," "The Commentators," "The Folios." The two last chapters contain notes on "The Tempest," and "A Midsummer Night's Dream."

Winslow.—FORCE and NATURE: ATTRACTION and REPULSION. The Radical Principles of Energy graphically discussed in their Relations to Physical and Morphological Development. By C. F. WINSLOW, M.D. 8vo, 14*s*.

The author having for long investigated Nature in many directions, has ever felt unsatisfied with the physical foundations upon which some branches of science have been so long compelled to rest. The question, he believes, must have occurred to many astronomers and physicists whether some subtle principle antagonistic to attraction does not also exist as an all-pervading element in nature, and so operate as in some way to disturb the action of what is generally considered by the scientific world a *unique* force. The aim of the present work is to set forth this subject in its broadest aspects, and in such a manner as to invite thereto the attention of the learned. The subjects of the eleven chapters are:—I. Space. II. Matter. III. Inertia, Force, and Mind. IV. Molecules. V. Molecular Force. VI. Union and Inseparability of Matter and Force. VII. and VIII. Nature and Action of Force—Attraction—Repulsion. IX. Cosmical Repulsion. X. Mechanical Force. XI. Central Forces and Celestial Physics.

Wurtz.—A HISTORY OF CHEMICAL THEORY, from the Age of Lavoisier down to the present time. By AD. WURTZ. Translated by HENRY WATTS, F.R.S. Crown 8vo, 6*s*.

"The discourse, as a *résumé* of chemical theory and research, unites singular luminousness and grasp. A few judicious notes are added by the translator."—*Pall Mall Gazette*.

Guillemin.—The FORCES of NATURE: A Popular Introduction to the Study of Physical Phenomena. By AMEDEE GUILLEMIN. Translated from the French by MRS. NORMAN LOCKYER; and Edited, with Additions and Notes, by J. NORMAN LOCKYER, F.R.S. Illustrated by 11 Coloured Plates and 455 Woodcuts. Second Edition. Imperial 8vo, cloth, extra gilt, 31*s*. 6*d*.

"Translator and Editor have done justice to their trust. The text has all the force and flow of original writing, combining faithfulness to the author's meaning with purity and independence in regard to idiom; while the historical precision and accuracy pervading the work throughout speak of the watchful editorial supervision which has been given to every scientific detail. Nothing can well exceed the clearness and delicacy of the illustrative woodcuts, borrowed from the French edition, or the purity and chromatic truth of the coloured plates. Altogether the work may be said to have no parallel, either in point of fulness or attraction, as a popular manual of physical science. . . . . What we feel, however, bound to say, and what we say with pleasure, is, that among works of its class no publication can stand comparison either in literary completeness or in artistic grace with it."—*Saturday Review*.

MACMILLAN & CO., LONDON.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR JUNE 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF JUNE NUMBER—Our Illustrations :—1. "An Italian Beauty," by A. Boulard. 2. "The Pet Dog," by Verwée. 3. "The Oak," by G. Courbet.—Cut Metal Work and Printed Tin-Foil Decorations.—The Exhibitions.—Art Notes and Gossip.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London : SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

THIS DAY, in 8vo, price 14s.

ESSAYS AND ADDRESSES.

BY

PROFESSORS & LECTURERS OF OWENS COLLEGE, MANCHESTER.

Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873.

CONTENTS.

OPENING ADDRESS. By the Duke of Devonshire, K.G. F.R.S., President of the Court of Governors.

"On some Relations of Culture to Practical Life." By J. G. Greenwood, Principal and Professor of Greek.

"Original Research as a Means of Education." By H. E. Roscoe, F.R.S., Professor of Chemistry.

"Solar Physics." By Balfour Stewart, F.R.S., Professor of Natural Philosophy.

"The Sun's Distance from the Earth." By T. H. Core, Professor of Natural Philosophy.

"The Limits of Geological Knowledge," By W. Boyd Dawkins, F.R.S., Curator of the Natural History Museum, and Lecturer in Geology and Palæontology.

"The Use of Steam." By Osborne Reynolds, Professor of Engineering.

"Primeval Vegetation in its Relation to the Doctrines of Natural Selection and Evolution." By W. C. Williamson, F.R.S., Professor of Natural History.

"Science and Medicine." By A. Gamgee, F.R.S., Professor of Practical Physiology and Histology.

"Some Historical Results of the Science of Language." By A. S. Wilkins, Professor of Latin and Comparative Philology.

"The Talmud." By T. Theodores, Professor of Oriental and Modern Languages.

"Provencal Poetry in Old and Modern Times." By H. Breymann, Lecturer on French Language and Literature.

"The Recent Reorganisation of the English Law Courts, in its Relation to their Past History." By J. Bryce, D.C.L., Professor of Jurisprudence and Law.

"The Railways and the State." By W. Stanley Jevons, F.R.S., Professor of Logic, and Mental and Moral Philosophy, and Political Economy.

"The Peace of Europe." By A. W. Ward, Professor of English and History.

MACMILLAN & CO., LONDON.

BRYANT & MAY'S

MATCHES.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London : JOHN VAN VOORST, 1, Paternoster Row.

MACMILLAN & CO.'S

GOLDEN TREASURY SERIES.

Uniformly Printed in 18mo., with Vignette Titles by Sir Noel Paton, T. Woolner, W. Holman Hunt, J. E. Millais, Arthur Hughes, &c. Engraved on Steel by Jeens. Bound in extra cloth, 4*s.* 6*d.* each volume. Also kept in morocco and calf bindings.

"*Messrs. Macmillan have, in their Golden Treasury Series, especially provided editions of standard works, volumes of selected poetry, and original compositions, which entitle this series to be called classical. Nothing can be better than the literary execution, nothing more elegant than the material workmanship.*"—British Quarterly Review.

The Golden Treasury of the Best Songs and Lyrical Poems in the English Language. Selected and arranged, with Notes, by Francis Turner Palgrave.

"*This delightful little volume, the Golden Treasury, which contains many of the best original lyric pieces and songs in our language, grouped with care and skill, so as to illustrate each other like the pictures in a well-arranged gallery.*"—Quarterly Review.

The Children's Garland from the best Poets. Selected and arranged by Coventry Patmore.

"*It includes specimens of all the great masters in the art of poetry, selected with the matured judgment of a man concentrated on obtaining insight into the feelings and tastes of childhood, and desirous to awaken its finest impulses, to cultivate its keenest sensibilities.*"—Morning Post.

The Book of Praise. From the best English Hymn Writers. Selected and arranged by Sir Roundell Palmer. A New and Enlarged Edition.

The Fairy Book; the best Popular Fairy Stories. Selected and rendered anew by the Author of "John Halifax, Gentleman."

"*A delightful selection, in a delightful external form; full of the physical splendour and vast opulence of proper fairy tales.*"—Spectator.

The Ballad Book. A Selection of the Choicest British Ballads. Edited by William Allingham.

"*His taste as a judge of old poetry will be found, by all acquainted with the various readings of old English ballads, true enough to justify his undertaking so critical a task.*"—Saturday Review.

The Jest Book. The Choicest Anecdotes and Sayings. Selected and arranged by Mark Lemon.

"*The fullest and best jest book that has yet appeared.*"—Saturday Review.

Bacon's Essays and Colours of Good and Evil. With Notes and Glossarial Index. By W. Aldis Wright, M.A.

The Pilgrim's Progress from this World to that which is to come. By John Bunyan.

"*A beautiful and scholarly print.*"—Spectator.

The Sunday Book of Poetry for the Young. Selected and arranged by C. F. Alexander.

"*A well-selected volume of sacred poetry.*"—Spectator.

A Book of Golden Deeds of all Times and all Countries. Gathered and narrated anew. By the Author of "The Heir of Redclyffe."

The Poetical Works of Robert Burns. Edited, with Biographical Memoir, Notes, and Glossary, by Alexander Smith. Two vols.

The Adventures of Robinson Crusoe. Edited from the Original Edition by J. W. Clark, M.A., Fellow of Trinity College, Cambridge.

The Republic of Plato. Translated into English, with Notes by J. Ll. Davies, M.A., and D. J. Vaughan, M.A.

The Song Book. Words and Tunes from the best Poets and Musicians. Selected and arranged by John Hullah, Professor of Vocal Music in King's College, London.

La Lyre Française. Selected and arranged, with Notes, by Gustave Masson, French Master in Harrow School.

Tom Brown's School Days. By An Old Boy.

A Book of Worthies. Gathered from the Old Histories and written anew by the Author of "The Heir of Redclyffe."

MACMILLAN & CO., LONDON.

Printed by R. Clay, Sons, & Taylor, at 7 and 8, Bread Street Hill, in the City of London, and published by Macmillan & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—Thursday, June 18, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 243, Vol. 10] THURSDAY, JUNE 25, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN AND IRELAND,

4, St. Martin's Place, Trafalgar Square, W.C.

A SPECIAL MEETING (to which Ladies will be admitted) will be held at the BETHNAL GREEN MUSEUM on WEDNESDAY, the 1st July, at 8 34 p m, when Col. Lane Fox will deliver a Lecture "On the Principle of Classification adopted in his Anthropological Collection exhibited in the Museum."

J. FRED. COLLINGWOOD, *Secretary*.

OWENS COLLEGE, MANCHESTER.

PROFESSORSHIP OF ANATOMY.

The Council propose to make an Appointment previous to the commencement of the next Winter Session, of a Professor of Anatomy in connection with the Medical Department of the College (with which is now incorporated the Manchester Royal School of Medicine, founded in 1824), and they invite Gentlemen willing to become Candidates to send in applications and testimonials addressed to the Council under cover to the Registrar not later than Saturday, 1st August next. The emoluments of the office will be derived from a stipend and a share of students' fees, and the Council will guarantee for a certain term that these together shall not be less than £500 per annum

Further information will be given on application to J. G Greenwood, LL D., Principal of the College.

J. HOLME NICHOLSON, Registrar

23rd June, 1874.

THE SCIENTIFIC CLUB.

The SCIENTIFIC CLUB having REMOVED from the WESTMINSTER PALACE HOTEL to their CLUB HOUSE. Applications for Memberships and other Communications should be addressed—

The Secretary,
Scientific Club,
7, Savile Row, Piccadilly, W.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr Debus, F R.S.; Dr. Frankland, F.R S.; Dr. Roscoe, F R.S; Dr. Angus Smith, F.R.S., Dr. Tyndall, F.R.S., Dr. Voelcker, F.R.S.; Dr. Williamson, F R.S.

C. WILLMORE, Principal.

BRITISH ASSOCIATION for the ADVANCEMENT OF SCIENCE,

22, Albemarle Street, London, W.

The NEXT ANNUAL GENERAL MEETING will be held at BELFAST, commencing on WEDNESDAY, August 19

President-Elect,

Professor TYNDALL, D.C L. LL D. F.R.S. F.C.S.

NOTICE TO CONTRIBUTORS OF MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ." If it should be inconvenient to the Author that his paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M A,
Assistant General Secretary, Harrow.

PHYSICAL GEOGRAPHY.—The PROFESSORSHIP is now VACANT in the Bedford College (for Ladies),

48 and 49, Bedford Square, London (In October the College will be removed to Nos. 8 and 9, York Place, Portman Square.) Applications are invited. Information may be obtained from the hon. sec. at the College.

JANE MARTINEAU, Hon Sec

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W

EDUCATION AT ZURICH.—Mr. DE BAUDISS,

formerly one of the Assistant Masters at Wellington College, receives a limited number of PUPILS, and will have vacancies in October The house is healthily situated, and the style of living is arranged to suit English habits. Mr. de Baudiss is assisted by competent Masters, and is able to offer, in addition to French and German and the usual subjects of a liberal education, special facilities for the study of Physical and Mechanical Science Advanced Pupils have the opportunity of attending the Lectures of the Polytechnic School, on Engineering, Agriculture, and other branches of Applied Science.—For terms and references apply to F de Baudiss, Wiesenstrasse, Seefeld Zurich.

READING SCHOOL.—A Natural Science MASTER will be required in September.—Apply, stating full particulars, to Rev. W. Stokoe, Reading.

PRIVATE TUITION.—A Clergyman, of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS Home comforts combined with great educational advantages. The highest references —M.A., care of Editor of NATURE, 29, Bedford Street, Strand, W.C.

SCIENCE TUITION by CORRESPONDENCE.—For Terms, apply to D.C L., care of Macmillan & Co., 29, Bedford Street, Strand, London, W.C

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given —Address, M.A H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W C.

SCIENCE TUITION by CORRESPONDENCE.—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope —For terms, &c, address H., care of Macmillan and Co., 29, Bedford Street, Strand, London, W C.

MICROSCOPE by Smith and Beck for Sale, with sub-stage, three eye-pieces, best objectives, and a quantity of expensive accessories The whole in Mahogany Cabinet, and cost £50 To be sold for £28. Apply by letter to R B., care of Macmillan & Co. 29, Bedford Street, Covent Garden, W C

TO NATURALISTS and CURATORS of MUSEUMS.—Sale of Valuable Osteological Specimens A Collection of very choice Osteological Specimens, including an admirably prepared Skeleton of a large Boa in glass case, with Crania of Tapir, Hippopotamus, Walrus, &c., and a variety of Preparations suited for Museums and Science Teachers, will be sold by auction on Monday next, the 29th of June, at 13, Wellington Street, Strand, by Messrs Sotheby, Wilkinson, and Hodge, of whom Catalogues may be had. A Cabinet of Choice Fossils and a valuable Collection of Minerals will be sold at the same time.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free SALMON ODY & CO., 292, Strand, London.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

Now ready,

NEGRETTI & ZAMBRA'S

NEW ENCYCLOPÆDIC CATALOGUE

Of Optical, Mathematical, Nautical, Electrical, Galvanic, Magnetic, Pneumatic, Hydraulic, Hydrostatic, Photographic, and Standard

METEOROLOGICAL INSTRUMENTS,

Containing very numerous Comparative Tables of Reference, and Illustrated by upwards of Eleven Hundred Engravings. Royal 8vo, cloth, gilt lettered. Price 5s. 6d.

NEGRETTI AND ZAMBRA,

SCIENTIFIC INSTRUMENT MANUFACTURERS, &c.,

HOLBORN VIADUCT,

45, Cornhill, 122, Regent Street, and Crystal Palace, Sydenham, London.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

Is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided, a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 " ... ... One Guinea.

Collections and Specimens of

British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

Third Edition, royal 8vo, cloth extra, 21s.

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S. With Appendices, Engravings, Maps, and Chromo-lithographs.

"The illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations"—*Saturday Review.*

"The lectures themselves furnish a most admirable elementary treatise on the subject, whilst by the insertion in appendices to each lecture of extracts from the most important published memoirs, the author has rendered it equally valuable as a text-book for advanced students."—*Westminster Review.*

MACMILLAN & CO., LONDON.

THE LINGUIST,

AND

EDUCATIONAL REVIEW.

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c., and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 19*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, S.W.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS COCOA

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

TISLEY'S PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern, packed in Deal Cabinet (3 ft × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free … per dozen	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3	0	7	6
Ditto traced on blackened Glass, for the Lantern … per slide	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution … £5 5 0

TISLEY AND SPILLER, OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of
ACHROMATIC MICROSCOPES,
and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals.
Monocular, £5, Binocular, £10 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to $\frac{1}{16}$ inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14*s.*, 4½ in., 17*s.*, 6 in., in Wooden Case, 10*s.*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

This day, royal 8vo, 764 pp , cloth, with over 200 Illustrations, price 34s.

ELEMENTS OF METALLURGY.

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.

Ancien Elève de l'Ecole des Mines, Paris; Author of "Mining and Metallurgy of Gold and Silver," &c.

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

This day is published.

MANUAL OF BOTANY,

ANATOMICAL AND PHYSIOLOGICAL.

FOR THE USE OF STUDENTS.

By ROBERT BROWN, M.A., Ph.D., F.L.S., F.R.G.S., &c.

Lecturer on Botany, Edinburgh.

360 Illustrations. Crown 8vo, 12*s.* 6*d.*

WILLIAM BLACKWOOD & SONS, Edinburgh and London.

A FEW ARTIST'S PROOFS

OF

THE PORTRAIT OF CHARLES DARWIN, F.R.S.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,

PRICE 5s. EACH,

OR THROUGH ANY BOOKSELLER.

ZOOLOGICAL SOCIETY'S LATEST PUBLICATIONS.

"Proceedings of the Scientific Meetings of the Society for 1874."—Part I, containing the Papers read at the Scientific Meetings in January and February, 1874. With 25 Plates, mostly coloured, 12s., with Plates, uncoloured, 3s.

INDEX to the Proceedings of the Zoological Society from 1830 to 1847, from 1848 to 1860, and from 1861 to 1870, in three volumes. Price 6s. each volume.

NOTICE.

Commencing from January of the present year the "Proceedings" will be issued in four Parts, as follows:—

Part I., containing Papers read in January and February, on June 1st.
" II., " " March and April, on August 1st.
" III, " " May and June, on October 1st.
" IV, " " November and December, on April 1st.

The price will be 12s. per Part for the Edition with coloured, and 3s per Part for that with uncoloured Plates.

TRANSACTIONS OF THE SOCIETY.

Vol. VIII., Part 7, price [illegible] Containing:—

Mr. ST. GEORGE MIVART, F.R.S.—"On the Axial Skeleton of the Ostrich" (*Struthio camelus*). (79 woodcuts.)

Vol. VIII., 8, price 24s. Containg the following Papers:—

"On the Osteology and Dentition of *Hylomys*" By JOHN ANDERSON, M.D., Curator of the Indian Museum, and Professor of Comparative Anatomy in the Medical College, Calcutta.

"Report on the Hydroida collected during the Expeditions of H.M.S. *Porcupine.*" By Professor G. J. ALLMAN, F.R.S.

"On the Osteology of the *Marsupialia.* (Part IV.) Bones of the trunk and limbs, *Phascolomys.*" By Professor OWEN, C B F.R.S. F.Z.S.

These publications may be obtained at the Society's Office, 11, Hanover Square, W.; at Messrs Longmans, the Society's Publishers, Paternoster Row, E C.: or through any bookseller.

ECLIPSES PAST and FUTURE, with GENERAL HINTS for OBSERVING the HEAVENS. By Rev. S. I JOHNSON, F.R.A.S Part I. An Account of Eclipses from the earliest times to the present, future eclipses, &c. Part II. A Description of Celestial Objects worth observing with a small telescope. 4s.

PARKER'S, 377, Strand.

NEW EDITION OF SIR W. R. GROVE'S WORK ON THE PHYSICAL FORCES.

On Tuesday, the 30th instant, in 1 vol. 8vo.

THE CORRELATION OF PHYSICAL FORCES. Sixth Edition, with other Contributions to Science By the Hon. Sir W. R Grove, M.A. F.R.S., one of the Judges of the Court of Common Pleas.

London: LONGMANS & CO., Paternoster Row.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES, RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible].)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal offically connected with brewing interests. Subscription, 16s. 6d per annum, post free, dating from any quarter-day, Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

DIARY OF SOCIETIES.

LONDON

THURSDAY, JUNE 25.

SOCIETY OF ANTIQUARIES, at 8.30.—On the Seal of Matilda, Countess of Perche: C. S. Percival.—On Discoveries at Rome: J. H. Parker, C B.

FRIDAY, JUNE 26.

QUEKETT MICROSCOPICAL CLUB, at 8.—Binocular Microscopes: S Holmes
JUNIOR PHILOSOPHICAL SOCIETY, at 8.—Cremation: Mr. Morrison.

TUESDAY, JUNE 30.

ROYAL HORTICULTURAL SOCIETY, at 2.—Meeting of Council.

WEDNESDAY, JULY 1.

ROYAL HORTICULTURAL SOCIETY.—Show of Cut Roses.
ANTHROPOLOGICAL INSTITUTE.—Special Meeting at Bethnal Green Museum.—Col. Lane Fox on the Principles of Classification in his Anthropological Collection.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s*. 6*d*.

Cloth Cases for binding all the volumes, price 1*s*. 6*d*. each.

Reading Cases to hold 26 numbers, price 2*s*. 6*d*.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

This day, in 8vo, price 14*s*., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M A With Glossary and Index

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London. MACMILLAN & CO

Second Edition, royal 8vo, cloth extra, 31*s*. 6*d*.

The FORCES of NATURE: a Popular Introduction to the Study of Physical Phenomena. By AMEDEE GUILLEMIN. Translated from the French by MRS. NORMAN LOCKYER, and Edited, with Additions and Notes, by J NORMAN LOCKYER, F.R.S. Illustrated by 11 Coloured Plates and 455 Woodcuts.

"Translator and editor have done justice to their trust. The text has all the force and flow of original writing, combining faithfulness to the author's meaning with purity and independence in regard to idiom, while the technical precision and accuracy pervading the work throughout speak of the watchful editorial supervision which has been given to every scientific detail Altogether, the work may be said to have no parallel, either in point of fulness or attraction, as a popular manual of physical science."—*Saturday Review.*

MACMILLAN & CO., LONDON.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c —Much trouble may be saved in grinding up colours to a uniform tint They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades

JUDSON'S DYES.—For Staining Wood.—Diluted with Water They sink deeply into the fibre, and will not rub off They form the most economical stain on record. Light Brown for mahogany colour is excellent, No. 2 Black for walnut, Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

HOLLOWAY'S OINTMENT and PILLS.—Rheumatism and Neuralgia.—Though the former disease remorselessly attacks the young and the robust, and the latter ruthlessly selects its victims from the weak and delicate, the same medical treatment will infallibly cure both complaints After the affected parts have been diligently fomented with hot brine, and the skin has been dried Holloway's Ointment must be well and perseveringly rubbed in for a few minutes twice a day, and his Pills must be taken according to the printed directions wrapped round each box of his medicine Both Ointment and Pills are accompanied by instructions designed for the public at large, and no invalid who attentively reads them can be at any loss how to doctor himself successfully.

POPULAR ASTRONOMY. By G. B. AIRY, Astronomer Royal. With Illustrations. Sixth and Cheaper Edition. 18mo, cloth, 4*s* 6*d*.

"Popular Astronomy in general has many manuals, but none of them supersede the Six Lectures of the Astronomer Royal under that title. Its speciality is the direct way in which every step is referred to the observatory, and in which the methods and instruments by which every observation is made are fully described This gives a sense of solidity and substance to astronomical statements which is obtainable in no other way."—*Guardian.*

MACMILLAN & CO., LONDON.

In royal 8vo, cloth extra gilt, price 31*s*. 6*d*.

CONTRIBUTIONS to SOLAR PHYSICS. By J. NORMAN LOCKYER, F R S. I. A Popular Account of Inquiries into the Physical Constitution of the Sun, with especial reference to Recent Spectroscopic Researches. II Communications to the Royal Society of London and the French Academy of Sciences, with Notes. Illustrated by 7 Coloured Lithographic Plates and 175 Woodcuts.

"The first part of the work, presenting the reader with a continuous sketch of the history of the various inquiries into the physical constitution of the sun, cannot fail to be of interest to all who care for the revelations of modern science; and the interest will be enhanced by the excellence of the numerous illustrations by which it is accompanied."—*Athenæum*

"The book may be taken as an authentic exposition of the present state of science in connexion with the important subject of spectroscopic analysis. . . . Even the unscientific public may derive much information from it"—*Daily News.*

London: MACMILLAN & CO.

WORKS IN PHYSIOLOGY, ANATOMY, &c.

Allbutt (T. C.)—On the USE of the OPHTHALMOSCOPE in Diseases of the Nervous System and of the Kidneys; also in certain other General Disorders. By THOMAS CLIFFORD ALLBUTT, M.A. M.D. Cantab., Physician to the Leeds General Infirmary, Lecturer on Practical Medicine, &c. 8vo, 15*s*.

The Ophthalmoscope has been found of the highest value in the investigation of nervous diseases. But it is not easy for physicians who have left the schools, and are engaged in practice, to take up a new instrument which requires much skill in using; it is therefore hoped that by such the present volume, containing the results of the author's extensive use of the instrument in diseases of the nervous system, will be found of value. After four introductory chapters on the history and value of the Ophthalmoscope, and the manner of investigating the states of the optic nerve and retina, the author treats of the various diseases with which optic changes are associated, and describes the way in which such associations take place. Besides the cases referred to throughout the volume, the Appendix contains details of 123 cases illustrative of the subjects discussed in the text, and a series of tabulated cases to show the ophthalmoscopic appearances of the eye in Insanity, Mania, Dementia, Melancholia and Monomania, Idiotcy, and General Paralysis. The volume is illustrated with two coloured plates of morbid appearances of the eye under the ophthalmoscope.

THE EFFECT of OVERWORK and STRAIN on THE HEART and GREAT BLOOD-VESSELS. (Reprinted from St. George's Hospital Reports.) 2*s*. 6*d*.

Anderson.—On the TREATMENT of DISEASES of the SKIN: with an Analysis of Eleven Thousand Consecutive Cases. By Dr. McCALL ANDERSON, Professor of Practice of Medicine in Anderson's University, Physician to the Dispensary for Skin Diseases, &c., Glasgow. Crown 8vo, cloth, 5*s*.

The first part of this work consists of a carefully tabulated and critical analysis of 11,000 cases of skin disease, 1,000 of these having occurred in the author's private practice, and the rest in his hospital practice. These cases are all classified under certain distinct heads, according to the nature and cause of the disease, while a number of the more interesting cases are alluded to in detail. The second part of the work treats of the Therapeutics of Diseases of the Skin, and will be found to contain many hints, the results of a long and extended experience, as to the most successful method of treating their multitudinous forms.

Anstie (F. E.)—NEURALGIA & DISEASES which RESEMBLE IT. By FRANCIS E. ANSTIE, M.D. M.R.C.P., Senior Assistant Physician to Westminster Hospital. 8vo, 10*s*. 6*d*.

The present treatise is the result of many years' careful independent scientific investigation into the nature and proper treatment of this most painful disease. The author has had abundant means of studying the subject both in his own person and in the hundreds of patients that have resorted to him for treatment. He has gone into the whole subject indicated in the title *ab initio*, and the publishers believe it will be found that he has presented it in an entirely original light, and done much to rob this excruciating and hitherto refractory disease of many of its terrors.

Barwell.—The CAUSES & TREATMENT of LATERAL CURVATURE of the SPINE. Enlarged from Lectures published in the *Lancet*. By RICHAD BARWELL, F.R.C.S., Surgeon to and Lecturer on Anatomy at the Charing Cross Hospital. Second Edition. Crown 8vo, 4*s*. 6*d*.

Corfield (Professor W. H.)—A DIGEST of FACTS RELATING to the TREATMENT and UTILISATION of SEWAGE. By W. H. CORFIELD, M.A. B.A., Professor of Hygiene and Public Health at University College, London. 8vo, 10*s*. 6*d*. Second Edition, corrected and enlarged.

The author in the Second Edition has revised and corrected the entire work, and made many important additions. The headings of the eleven chapters are as follow:—I. Early Systems. Midden-Heaps and Cesspools. II. Filth and Disease—Cause and Effect. III. Improved Midden-Pits and Cesspools; Midden-Closets, Pail-Closets, &c. IV. The Dry Closet Systems. V. Water-Closets. VI. Sewerage. VII. Sanitary Aspects of the Water-Carrying System. VIII. Value of Sewage; Injury to Rivers. IX. Town Sewage; Attempts at Utilisation. X. Filtration and Irrigation. XI. Influence of Sewage Farming on the Public Health.—An abridged account of the more recently published researches on the subject will be found in the Appendices, while the Summary contains a concise statement of the views which the author himself has been led to adopt: references have been inserted throughout to show from what sources the numerous quotations have been derived, and an Index has been added.

Elam (C.)—A PHYSICIAN'S PROBLEMS. By CHARLES ELAM, M.D. M.R.C.P. Crown 8vo, 9*s*.

CONTENTS:—"Natural Heritage." "On Degeneration in Man." "On Moral and Criminal Epidemics." "Body *v*. Mind." "Illusions and Hallucinations." "On Somnambulism." "Reverie and Abstraction." These Essays are intended as a contribution to the Natural History of those outlying regions of Thought and Action whose domain is the debateable ground of Brain, Nerve, and Mind. They are designed also to indicate the origin and mode of perpetuation of those varieties of organisation, intelligence, and general tendencies towards vice or virtue, which seem to be so capriciously developed among mankind. They also point to causes for the infinitely varied forms of disorder of nerve and brain—organic and functional—far deeper and more recondite than those generally believed in.

Fox.—Works by Wilson Fox, M.D., Lond., F.R.C.P., Holme Professor of Clinical Medicine, University College, London, Physician Extraordinary to her Majesty the Queen, &c.:—

DISEASES of the STOMACH: being a new and revised Edition of the "Diagnosis and Treatment of the Varieties of Dyspepsia." 8vo, 8*s*. 6*d*.

"The author has accomplished his design of making the treatise as complete as possible, in relation to the numerous researches on the subject down to the present time. We believe that few, whether students or practitioners, will rise from the perusal of the work without feeling, as we do ourselves, that the study of it has been attended with pleasure and advantage."—*Lancet.*

ON the ARTIFICIAL PRODUCTION of TUBERCLE in the LOWER ANIMALS. With Coloured Plates. 4to, 5*s*. 6*d*.

In this Lecture Dr. Fox describes in minute detail a large number of experiments made by him on guinea-pigs and rabbits for the purpose of inquiring into the origin of Tubercle by the agency of direct irritation or by septic matters. This method of inquiry he believes to be one of the most important advances which have been recently made in the pathology of the disease. The work is illustrated by three plates, each containing a number of carefully coloured illustrations from nature.

MACMILLAN & CO., LONDON.

WORKS IN PHYSIOLOGY, ANATOMY, &c.

Fox.—(Continued.)

ON THE TREATMENT OF HYPERPYREXIA, as Illustrated in Acute Articular Rheumatism by means of the External Application of Cold. 8vo. 2*s.* 6*d.*

The object of this work is to show that the class of cases included under the title, and which have hitherto been invariably fatal, may, by a judicious use of the cold bath and without venesection, be brought to a favourable termination. Minute details are given of the successful treatment by this method of two patients by the author, followed by a Commentary on the cases, in which the merits of the mode of treatment are discussed and compared with those of methods followed by other eminent practitioners. Appended are tables of the observations made on the temperature during the treatment; a table showing the effect of the immersion of the patients in the baths employed, in order to exhibit the rate at which the temperature was lowered in each case; a table of the chief details of twenty-two cases of this class recently published, and which are referred to in various parts of the Commentary. Two Charts are also introduced, giving a connected view of the progress of the two successful cases, and a series of sphygmographic tracings of the pulses of the two patients. "A clinical study of rare value. Should be read by everyone."—*Medical Press and Circular.*

Galton (D.)—AN ADDRESS on the GENERAL PRINCIPLES WHICH SHOULD BE OBSERVED IN THE CONSTRUCTION of HOSPITALS.

Delivered to the British Medical Association at Leeds, July 1869. By DOUGLAS GALTON, C.B., F.R.S. Crown 8vo. 3*s.* 6*d.*

In this Address the author endeavours to enunciate what are those principles which seem to him to form the starting-point from which all architects should proceed in the construction of hospitals. Besides Mr. Galton's paper the book contains the opinions expressed in the subsequent discussion by several eminent medical men, such as Dr. Kennedy, Sir James Y. Simpson, Dr. Hughes Bennet, and others. The work is illustrated by a number of plans, sections, and other cuts. "An admirable exposition of those conditions of structure which most conduce to cleanliness, economy, and convenience."—*Times.*

Hood (Wharton).—ON BONE-SETTING

(so called), and its RELATION to the TREATMENT of JOINTS CRIPPLED by INJURY, RHEUMATISM, INFLAMMATION, &c., &c. By WHARTON P. HOOD, M.D., M.R.C.S. Crown 8vo. 4*s.* 6*d.*

The author for a period attended the London practice of the late Mr. Hutton, the famous and successful bone-setter, by whom he was initiated into the mystery of the art and practice. Thus the author is amply qualified to write on the subject from the practical point of view, while his professional education enables him to consider it in its scientific and surgical bearings. In the present work he gives a brief account of the salient features of a bone-setter's method of procedure in the treatment of damaged joints, of the results of that treatment, and of the class of cases in which he has seen it prove successful. The author's aim is to give the rationale of the bone-setter's practice, to reduce it to something like a scientific method, to show when force should be resorted to and when it should not, and to initiate surgeons into the secret of Mr. Hutton's successful manipulation. Throughout the work a great number of authentic instances of successful treatment are given, with the details of the method of cure; and the Chapters on Manipulations and Affections of the Spine are illustrated by a number of appropriate and well-executed cuts. "Dr. Hood's book is full of instruction, and should be read by all surgeons."—*Medical Times.*

Humphry.—Works by G. M. Humphry,

M.D., F.R.S., Professor of Anatomy in the University of Cambridge, and Honorary Fellow of Downing College:—

Humphry.—(Continued.)

THE HUMAN SKELETON (including the Joints). With 260 Illustrations, drawn from nature. Medium 8vo, 28*s.*

In lecturing on the Skeleton it has been the author's practice, instead of giving a detailed account of the several parts, to request his students to get up the descriptive anatomy of certain bones, with the aid of some work on osteology. He afterwards tested their acquirements by examination, endeavouring to supply deficiencies and correct errors, adding also such information—physical, physiological, pathological, and practical—as he had gathered from his own observation and researches, and which was likely to be useful and excite an interest in the subject. This additional information forms, in great part, the material of this volume, which is intended to be supplementary to existing works on anatomy. Considerable space has been devoted to the description of the joints, because it is less fully given in other works, and because an accurate knowledge of the structure and peculiar form of the joints is essential to a correct knowledge of their movements. The numerous illustrations were all drawn upon stone from nature; and in most instances, from specimens prepared for the purpose by the author himself. "Bearing at once the stamp of the accomplished scholar, and evidences of the skilful anatomist."—*Medical Times and Gazette.*

OBSERVATIONS IN MYOLOGY. 8vo, 6*s.*

Prof. Humphry's previous works have gained for him a very high position as an original anatomist, and the present it is believed will fully sustain that reputation, as well as prove valuable to all who take an interest in the higher problems of anatomy. The work includes the Myology of Cryptobranch, Lepidosiren, Dog-Fish, Ceratodus, and Pseudopus pallasii, with the Nerves of Cryptobranch and Lepidosiren and the Disposition of Muscles in Vertebrate Animals. The volume abounds in carefully executed illustrations.

JOURNAL OF ANATOMY AND PHYSIOLOGY.

Conducted by Professors HUMPHRY and NEWTON, and Mr. CLARK of Cambridge, Prof. TURNER of Edinburgh, and Dr. WRIGHT of Dublin. Published twice a year. Old Series, Parts I. and II., price 7*s.* 6*d.* each. Vol. I. containing Parts I. and II., Royal 8vo, 16*s.* New Series, Parts I. to IX. 6*s.* each, or yearly Vols. 12*s.* 6*d.* each.

Lankester.—COMPARATIVE LONGEVITY in MAN AND the LOWER ANIMALS.

By E. RAY LANKESTER, B.A. Crown 8vo, 4*s.* 6*d.*

This Essay gained the prize offered by the University of Oxford for the best paper on the subject which it treats. This interesting subject is here treated in a thorough manner, both scientifically and statistically.

Maclaren.—TRAINING in THEORY and PRACTICE.

By ARCHIBALD MACLAREN, the Gymnasium, Oxford, crown 8vo. Second and enlarged edition, 6*s.* 6*d.*

The ordinary agents of Health are Exercise, Diet, Sleep, Air, Bathing, and Clothing. In this work the author examines each of these agents in detail, and from two different points of view. First, as to the manner in which it is, or should be, administered under ordinary circumstances: and secondly, in what manner and to what extent this mode of administration is, or should be, altered for purposes of training; the object of "training," according to the author, being "to put the body, with extreme and exceptional care, under the influence of all the agents which promote its health and strength, in order to enable it to meet extreme and exceptional demands upon its energies." Appended are various diagrams and tables relating to boat-racing, and tables connected with diet and training. "The philosophy of human health has seldom received so apt an exposition."—*Globe.* "After all the nonsense that has been written about training, it is a comfort to get hold of a thoroughly sensible book at last."—*John Bull.*

MACMILLAN & CO., LONDON.

E. DENT & CO., 61, Strand, & 34, Royal Exchange.
(FACTORY, SAVOY ST.), LONDON.

MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), **COMPASSES, &c.,**
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.

MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.

MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.

Catalogues or Estimates on Application.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr Lankester, September 30, 1867; Dr. Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10s and upwards. Portable Filters on this system, £1 5s. to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R H. the Prince of Wales, at Sandringham; by H.R H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s. each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2d.

IN THE PRESS.

İSMAILÏA

A NARRATIVE OF
THE EXPEDITION TO CENTRAL AFRICA
FOR THE SUPPRESSION OF
THE SLAVE TRADE.
ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.

By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,

Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.

MACMILLAN & CO., LONDON.

THIS DAY, in 8vo, price 14s.

ESSAYS AND ADDRESSES.
BY
PROFESSORS & LECTURERS OF OWENS COLLEGE, MANCHESTER.

Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873.

CONTENTS.

OPENING ADDRESS. By the Duke of Devonshire, K.G. F.R.S., President of the Court of Governors.

"On some Relations of Culture to Practical Life." By J. G. Greenwood, Principal and Professor of Greek.

"Original Research as a Means of Education." By H. E. Roscoe, F.R.S., Professor of Chemistry.

"Solar Physics." By Balfour Stewart, F.R.S., Professor of Natural Philosophy.

"The Sun's Distance from the Earth." By T. H. Core, Professor of Natural Philosophy.

"The Limits of Geological Knowledge," By W. Boyd Dawkins, F.R.S., Curator of the Natural History Museum, and Lecturer in Geology and Palæontology.

"The Use of Steam." By Osborne Reynolds, Professor of Engineering.

"Primeval Vegetation in its Relation to the Doctrines of Natural Selection and Evolution." By W. C. Williamson, F.R.S., Professor of Natural History.

"Science and Medicine." By A. Gamgee, F.R.S., Professor of Practical Physiology and Histology.

"Some Historical Results of the Science of Language." By A. S. Wilkins, Professor of Latin and Comparative Philology.

"The Talmud." By T. Theodores, Professor of Oriental and Modern Languages.

"Provencal Poetry in Old and Modern Times." By H. Breymann, Lecturer on French Language and Literature.

"The Recent Reorganisation of the English Law Courts, in its Relation to their Past History." By J. Bryce, D.C.L., Professor of Jurisprudence and Law.

"The Railways and the State." By W. Stanley Jevons, F.R.S., Professor of Logic, and Mental and Moral Philosophy, and Political Economy.

"The Peace of Europe." By A. W. Ward, Professor of English and History.

MACMILLAN & CO., LONDON.

---

ed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co
at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, June 25, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 244 Vol. 10] THURSDAY, JULY 2, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office

[All Rights are Reserved

BRITISH ASSOCIATION for the ADVANCEMENT OF SCIENCE,

22, Albemarle Street, London, W.

The NEXT ANNUAL GENERAL MEETING will be held at BELFAST, commencing on WEDNESDAY, August 19

President-Elect,

Professor TYNDALL, D.C.L. LL D F R S F C S.

NOTICE TO CONTRIBUTORS OF MEMOIRS —Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ." If it should be inconvenient to the Author that his paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G GRIFFITH, M.A ,
Assistant General Secretary, Harrow.

OWENS COLLEGE, MANCHESTER.

PROFESSORSHIP OF ANATOMY

The Council propose to make an Appointment previous to the commencement of the next Winter Session, of a Professor of Anatomy in connection with the Medical Department of the College (with which is now incorporated the Manchester Royal School of Medicine, founded in 1824), and they invite Gentlemen willing to become Candidates to send in applications and testimonials addressed to the Council under cover to the Registrar not later than Saturday, 1st August next The emoluments of the office will be derived from a stipend and a share of students' fees, and the Council will guarantee for a certain term that these together shall not be less than £500 per annum

Further information will be given on application to J G Greenwood, LL D , Principal of the College

J HOLME NICHOLSON, Registrar

23rd June, 1874.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus. F.R S. , Dr. Frankland, F.R S. ; Dr. Roscoe, F R S ; Dr. Angus Smith, F R.S. ; Dr Tyndall, F R.S. ; Dr. Voelcker, F R S. ; Dr. Williamson, F.R S

C. WILLMORE, Principal.

PROFESSORSHIP IN BIOLOGY.

DURHAM UNIVERSITY COLLEGES of MEDICINE and PHYSICAL SCIENCE,

Newcastle-upon-Tyne —It is proposed to establish a Chair of Biology combined with Physiology, in connection with the above Institutions, in October next Salary £450, with a portion of fees Candidates for the office are invited to apply (with testimonials) to Theo. Wood Bunning, Secretary to the College of Physical Science, Newcastle, before the 15th August next, from whom full particulars as to duties, &c , may be obtained

---

READING SCHOOL.—A Natural Science MASTER

will be required in September —Apply, stating full particulars, to Rev. W. Stokoe, Reading

---

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate Analyses and Investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S A., 44, Berners Street, W

OLDHAM SCHOOL of SCIENCE and ART

—ADDITIONAL LABORATORY APPARATUS is required for Students experimenting in Light, Sound, Heat, Magnetism and Electricity. Manufacturers are requested to send latest price-lists to J. P. Phythian, C E , Science Master.

LINNEAN SOCIETY.—This day is published,

price £1 10s , the First Part of Vol XXX of the TRANSACTIONS of the LINNEAN SOCIETY of LONDON. Sold by Longmans and Co , Paternoster Row, and by Mr Kippist, at the Apartments of the Society, Burlington House, Piccadilly, of whom may be had all or any of the preceding volumes. The Fellows of the Society are requested to apply to Mr. Kippist for their Copies between the hours of 12 and 4 o'clock.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY,

1841–1872, is now ready, including both Authors' Names and Subjects It may be obtained by Fellows at the Society's Rooms, price 5s , by post 5s. 4d ; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY

now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1s

TO NATURALISTS and CURATORS of MUSEUMS.—Sale of Valuable Osteological Specimens. A Collection of very choice Osteological Specimens, including an admirably prepared Skeleton of a large Boa in glass case, with Crania of Tapir, Hippopotamus, Walrus, &c., and a variety of Preparations suited for Museums and Science Teachers, to be sold at 13, Wellington Street, Strand, by Messrs. Sotheby, Wilkinson, and Hodge, of whom Catalogues may be had. A Cabinet of Choice Fossils and a valuable Collection of Minerals also to be sold.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

TO BE SOLD.—A Collection of British Bird-skins, Eggs, and Insects in Oak Cabinets.—For further particulars apply to "Oologist," care of Editor of NATURE, 29, Bedford Street, Strand, London, W.C.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s. Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 " ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.
Detailed Catalogues post-free

W. LADD & CO.
SCIENTIFIC INSTRUMENT MANUFACTURERS
(By Appointment to the Royal Institution of Great Britain).
Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.
11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.
ESTABLISHED 1843.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

HENRY CROUCH'S
NEW CATALOGUE OF
MICROSCOPES, OBJECTIVES, &c.
With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.
HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,
Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

TISLEY'S
PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern, packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0	7	6
Ditto traced on Blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5	5	0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

PURE AERATED WATERS.
ELLIS'S
RUTHIN WATERS,
Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS.—W. BEST & SONS, Henrietta Street, Cavendish Square.

RUPTURES.—BY ROYAL LETTERS PATENT.
WHITE'S MOC-MAIN LEVER TRUSS
is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

TRADE MARK

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d. } Post-free.
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B., F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s 6d. bound in cloth); also covers for the volume (price 1s.), and back numbers.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations. Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N B.—Communications, &c., should be sent to the Editors at the above address.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Store.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 10s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

MACMILLAN'S MAGAZINE.

No. 177. FOR JULY.

PRICE 1s.

CONTAINS—

1.—"Slavery and the Slave Trade." By Sir Samuel White Baker, Pasha, M.A., F.R.S., F.R.G.S., &c.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XIV.—XVI.
3.—"The Shadow of Death." By Sidney Colvin
4.—"Michelet." By Gabriel Monod, Directeur à l'École des Hautes Études, Paris.
5.—"The Caliph's Draught" By Edwin Arnold.
6.—"The Convent of San Marco" I. The Painter.
7.—"The Persian Poet Hafiz." By Prof. Cowell.
8.—"A Curious Product"
9.—"Requiescit." By J. W. Hales.
10.—"The Esthonian Hercules." By John Oxenford.
11.—Two Addresses by the Dean of Westminster. I. John Bunyan. II. Arnold and Rugby.

MACMILLAN & CO., London.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES. — Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

SCOTTISH PROVIDENT INSTITUTION,

EDINBURGH: 6, St. Andrew Square. LONDON: 18, King William Street, E.C.

ITS ADVANTAGES over other offices are:—
A larger immediate assurance for the same premium, with the prospect to good lives of eventually receiving very considerable additions.

Thus £1,200 or £1,250 may be secured at once for the premium usually charged for £1,000 only; and policies originally for, say, £1,000, have been increased to £1,170, £1,450, £1,600, and in some cases have been doubled.

FINANCIAL POSITION.

The Fund, accumulated entirely from the premiums, exceeds £2,250,000. Notwithstanding its low rates, no Office of the same age (Established 1837) has so large a Fund, or shows so large an increase from year to year.

This day, royal 8vo, 764 pp, cloth, with over 200 Illustrations, price 34*s*.

ELEMENTS OF METALLURGY.

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.

Ancien Elève de l'Ecole des Mines, Paris; Author of "Mining and Metallurgy of Gold and Silver," &c.

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

A FEW ARTIST'S PROOFS
OF

THE PORTRAIT OF CHARLES DARWIN, F.R.S.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,
PRICE 5s. EACH,
OR THROUGH ANY BOOKSELLER.

ECLIPSES PAST and FUTURE, with GENERAL HINTS for OBSERVING the HEAVENS. By Rev. S. J. JOHNSON, F.R.A.S. Part I. An Account of Eclipses from the earliest times to the present, future eclipses, &c. Part II. A Description of Celestial Objects worth observing with a small telescope. 4*s*.

PARKER'S, 377, Strand.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle.—*Athenæum*.

"The chart cannot fail to be very useful to the keepers of horses and neat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times*.

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water*.

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading.

Price 6*d*. per month, or 5*s*. per annum, Post Free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s*. 6*d*. each

PREPARING FOR PUBLICATION (*Second Edition*):

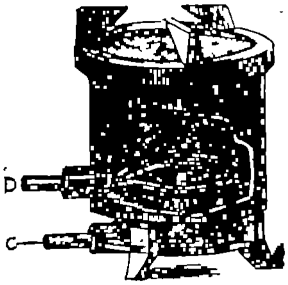
THE MINERAL CONSTITUENTS REMOVED FROM AN ACRE OF SOIL by an Average Crop of Wheat, Oats, Barley, Turnips, &c; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

1871.—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873.—INTERNATIONAL EXHIBITION PRIZE MEDAL.

FLETCHER'S

NEW LOW TEMPERATURE BURNER (PATENT)



This Burner gives a range of heating power from a gentle current of WARM air to a BRIGHT RED HEAT, and is so perfectly under control that a common glass bottle may be placed on the tripod without protection and heated to any required temperature without the slightest risk of fracture. In practical use it dispenses with the necessity for drying-closets, sand-and-water baths, &c.

For very low temperatures the ring must be lighted through the opening B, this causes a current of warm air to rise through the gauze above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube.

Price, without blast tube ... ... 7*s*. 6*d*.
" with blast tube for high temperatures ... 9*s*. 0*d*.

UNIVERSAL FURNACE (GAS),

For High Temperatures (without blast) for Crucibles, Muffles, &c, in several sizes and patterns. Special designs made to order

NEW BUNSEN BURNERS, giving a range of temperature up to a clear white heat. 10*s*. 6*d*.

HOT BLAST BLOWPIPES, giving temperatures exceeding the fusing-point of platinum, 11*s* 6*d*., 13*s*., 15*s*.

POWERFUL FOOT-BLOWERS, 18*s*.

Drawings and description from dealers in Chemical Apparatus, or from

THOMAS FLETCHER, F.C.S.,
13 & 15, SUEZ STREET,
WARRINGTON.

DIARY OF SOCIETIES.

LONDON

FRIDAY, JULY 3.

GEOLOGISTS' ASSOCIATION, at 8.

MONDAY, JULY 6.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c.*, *at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

Third Edition, royal 8vo, cloth extra, 21*s.*

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S. With Appendices, Engravings, Maps, and Chromo-lithographs.

"The illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations."—*Saturday Review.*

"The lectures themselves furnish a most admirable elementary treatise on the subject, whilst by the insertion in appendices to each lecture of extracts from the most important published memoirs, the author has rendered it equally valuable as a text-book for advanced students."—*Westminster Review.*

MACMILLAN & CO., LONDON.

Works by Francis Galton, F.R.S.

METEOROGRAPHICA, or Methods of Mapping the Weather. Illustrated by upwards of 600 Printed Lithographic Diagrams. 4to, 9*s.*

As Mr. Galton entertains strong views on the necessity of meteorological charts and maps, he determined, as a practical proof of what could be done, to chart the area of Europe, so far as meteorological stations extend, during one month, viz. the month of December 1861. Mr. Galton got his data from authorities in every part of Britain and the Continent, and on the basis of these has here drawn up nearly a hundred different maps and charts, showing the state of the weather all over Europe during the above period.

HEREDITARY GENIUS: An Inquiry into its Laws and Consequences. Demy 8vo, 12*s.*

"A most able and most interesting book."—*Times.* "We know, through the admirable labours of Mr. Galton, that Genius tends to be inherited."—Darwin's "Descent of Man," vol. i. p. 3.

MACMILLAN & CO., LONDON.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

FOR EXCELLENCE AND CHEAPNESS

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.

Pillischer's St. Thomas's Hospital Microscope,

As supplied to the principal Universities and Hospitals.

Monocular, £5, Binocular, £10 10*s*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from $\frac{1}{4}$ to $\frac{1}{25}$ inch, unequalled for their brilliant Defining and Penetrating Power

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in, 14*s.*, 4½ in, 17*s*, 6 in, in Wooden Case, 10*s*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

BRYANT & MAY'S MATCHES.

HOLLOWAY'S PILLS.—This Medicine has been constantly increasing in public estimation for many years, and is now acknowledged to be the most wonderful remedy in the world. It acts directly on the system, removes all obstructions from the stomach, tempers the springs of life, purifies the blood, and totally eradicates liver complaint (that mainspring of so many diseases), indigestion loss of appetite, pain in the side, &c. It is also a remedy on which the asthmatic may place the greatest dependence, the debilitated the greatest reliance, that they will therefrom obtain perfect restoration to health. These Pills maintain functional regularity, and as a consequence dispel low spirits, common to human nature at all ages under untoward circumstances

An INTRODUCTION to the OSTEOLOGY of the MAMMALIA. Being the substance of the Course of Lectures delivered at the Royal College of Surgeons of England in 1870. By W. H. FLOWER, F.R.S., F.R.C.S., Hunterian Professor of Comparative Anatomy and Physiology. With numerous Illustrations. Globe 8vo, 7*s.* 6*d.*

Although the present work contains the substance of a Course of Lectures the form has been changed, so as the better to adapt it as a handbook for students. Theoretical views have been almost entirely excluded; and while it is impossible in a scientific treatise to avoid the employment of technical terms, it has been the author's endeavour to use no more than absolutely necessary, and to exercise due care in selecting only those that seem most appropriate, or which have received the sanction of general adoption. With a very few exceptions the illustrations have been drawn expressly for this work from specimens in the Museum of the Royal College of Surgeons.

MACMILLAN & CO., LONDON.

NEW BOOKS.

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the Orders of Her Majesty's Government; with Incidental Notices of the Countries through which the Lines pass. By Colonel Sir FREDERIC GOLDSMID, C.B. K.C.S.I., late Director of the Government Indo-European Telegraph. With numerous Illustrations and Maps, 8vo. [Immediately.

ESSAYS and ADDRESSES, by PROFESSORS and LECTURERS of Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. 8vo, 14s. [This day.

Among the contributors to this volume are the following:—The Duke of Devonshire, K.G. F.R.S., Prof. Greenwood (Principal), Prof. Roscoe, F.R.S., Prof. Balfour Stewart, F.R.S., Prof. Williamson, F.R.S., Prof. Gamgee, F.R.S., Prof. Bryce, D.C.L., Prof. Jevons, F.R.S., &c.

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices, by B. H. KENNEDY, D.D., Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6s. [Just ready.

HORÆ HELLENICÆ. Essays and Discussions on some Important Points of Greek Philology and Antiquity. By JOHN STUART BLACKIE, F.R.S.E., Professor of Greek in the University of Edinburgh. 8vo, 12s. [This day.

SOME LEADING PRINCIPLES of POLITICAL ECONOMY newly EXPOUNDED. By J. E. CAIRNES, M.A., Emeritus Professor of Political Economy in University College, London. 8vo, 14s. [This day.

"It is with great pleasure that we welcome another contribution to political economy from the ablest living representative of the school of Ricardo and Mill."—*Saturday Review.*

"The most important part of this volume is that which deals with cost of production and of value as determined by cost. It is on this subject that Prof. Cairnes has rendered the most signal service to the progress of economic science; and, if we mistake not, his investigations will mark an era in the history of political economy as distinct as, and scarcely less important than, those connected with the names of Ricardo, Malthus, and Mill."—*Athenæum.*

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor MASSON, Crown 8vo. [Immediately.

THOUGHTS on REVELATION. By JOHN M'LEOD CAMPBELL, D.D. Second Edition, crown 8vo, 5s. [This day.

BIRDS: their Cages and their Keep. By Lady DICKEY. With Illustrations. Crown 8vo. [Shortly.

NEW VOLUME OF "*NATURE* SERIES."

The TRANSIT of VENUS. By George FORBES, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With numerous Illustrations, crown 8vo. [Shortly.

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER of PHYSIOLOGY. By Michael FOSTER, F.R.S. With Illustrations, 18mo. [Shortly.

NEW VOLUME OF "THE GOLDEN TREASURY SERIES."

SCOTTISH SONG.—A Selection of the Choicest LYRICS of SCOTLAND. Compiled and Arranged, with Brief Notes, by MARY CARLYLE AITKEN. 18mo, 4s. 6d. [This day.

Twelfth Edition, Revised.

NOTES on the PARABLES of OUR LORD. By R. CHENEVIX TRENCH, D.D., Archbishop of Dublin. 8vo, 12s. [This day.

A NEW FRENCH DICTIONARY.

A COMPENDIOUS DICTIONARY of the FRENCH LANGUAGE (French-English and English-French). Followed by a List of the Principal Diverging Derivations, and preceded by Chronological and Historical Tables. By GUSTAVE MASSON, Assistant-Master and Librarian, Harrow School. Square half bound, 6s. [This day.

This volume, though cast in the same form as other dictionaries, has several distinctive features which increase its value for the student. In the French-English part, etymologies, founded on the researches of Messrs. Littré, Scheler, and Brachet, are given. The list of diverging derivations, at the end of the volume, will be very useful to those who are interested in tracing the various developments of original Latin words. But that which makes it almost indispensable to students of the political and literary history of France, is to be found at the beginning of the work, where M. Masson has drawn up clear and complete tables of historical events, viewed in connection with the developments of literature and language, between the death of Charlemagne, 814 A.D., and that of Louis Philippe, 1850. These tables are illustrated by remarks on the various social moods, of which the works produced were the expression. Appended also is a list of the principal Chronicles and Memoirs on the History of France which have appeared up to the present time; the French Republican Calendar, compared with the Gregorian; and a Chronological List of the principal French Newspapers published during the Revolution and the First Empire. We feel sure that all who study this work will allow that the author has signally overcome the lexicographer's natural tendency to dryness. As a dictionary, it is unusually copious, and as a book remarkably handy.

THIRD AND CHEAPER EDITION, SOMEWHAT ABRIDGED.

JOHN COLERIDGE PATTESON'S LIFE. By CHARLOTTE M. YONGE, Author of "The Heir of Redclyffe." With Two Portraits, engraved by Jeens. 2 vols. crown 8vo, 12s. [This day.

"Miss Yonge's book is in one respect a model biography. It is made up almost entirely of Patteson's own letters. Aware that he had left his home for once and for all, his correspondence took the shape of a diary, and as we read on we come to know the man, and to love him almost as if we had seen him."—*Athenæum.*

"Such a life, with its grand lessons of unselfishness, is a blessing and an honour to the age in which it is lived: the biography cannot be studied without pleasure and profit, and, indeed, we should think little of the man who did not rise from the study of it better and wiser. Neither the Church nor the Nation which produces such sons need ever despair of its future."—*Saturday Review.*

Nearly ready, No. X. of

The JOURNAL of PHILOLOGY. Edited by W. G. CLARK, M.A., Fellow of Trinity College; J. E. B. MAYOR, M.A., Fellow of St. John's College, and W. ALDIS WRIGHT, M.A., Trinity College, Cambridge.

Contents:—

On Glossology (continued). The late Professor Grote.
On the Word [illegible] in the Equites of Aristophanes, v. 89. W. H. Thompson.
The Classification of Conditional Sentences in Greek Syntax. W. W. Goodwin.
On the Interpretation of Plato, Timæus, p. 40 C. L. Campbell.
Platonica. W. H. Thompson.
On the Place of a Fragment of Æschylus. No. 437 Dindorf, 124 Nauck. D. C. Tovey.
On the Existence of Written Histories in the Time of Thucydides (B.C. 470–400). F. A. Paley.
The [illegible] of Socrates. Henry Jackson.
Proposed Emendations of the Text of Origen against Celsus. Books I., II., III., IV. William Selwyn.
On the Newly-Edited Poems of Dracontius. R. Ellis.
On two Passages of Statius's Silvæ. R. Ellis.
On Sulpiciæ Satira. R. Ellis.
On the Sixth Letter of Isokrates. R. C. Jebb.
On the Homeric Words [illegible]. F. A. Paley.
On the Etymology of certain Words in English terminating in *SH* and *SK*. Eiríkr Magnússon.
Love Amor. Love Nought. Eiríkr Magnússon.
Catullus's 54th Poem. H. A. J. Munro.

MACMILLAN & CO., LONDON.

NEW BOOKS AND NEW EDITIONS.

ETRUSCAN RESEARCHES. By Isaac Taylor, M.A. With Glossary and Index. This day, in 8vo, price 14*s*., with Woodcuts.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographic Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

WORTHIES of ALL SOULS. Four Centuries of English History, Illustrated from the College Archives. By MONTAGU BURROWS, Chichele Professor of Modern History at Oxford, Fellow of All Souls. 8vo. 14*s*. [*Next week.*

WILLIAM CARSTARES: a Character and Career of the Revolutionary Epoch (1649-1715). By ROBERT H. STORY, Minister of Rosneath. With Portrait Engraved by Jeens. 8vo. [*Shortly.*

"William had, however, one Scottish adviser who deserved and possessed more influence than any of the ostensible ministers. This was Carstares, one of the most remarkable men of that age. He united great scholastic attainments with great aptitude for civil business, and the firm faith and ardent zeal of a martyr with the shrewdness and suppleness of a consummate politician. In courage and fidelity he resembled Burnet; but he had what Burnet wanted—judgment, self-command, and a singular power of keeping secrets. There was no post to which he might not have aspired if he had been a layman, or a priest of the Church of England."—*Macaulay's History of England.*

By SEA and by LAND: a Trip through Egypt, India, Ceylon, Australia, New Zealand, and America. By HENRY A. MEREWETHER, one of Her Majesty's Counsel. Crown 8vo. 3*s*. 6*d*.

HIGHER SCHOOLS and UNIVERSITIES in GERMANY. By Matthew ARNOLD, D.C.L., formerly Foreign Assistant-Commissioner to the Schools' Inquiry Commission. With a New Preface, comparing the Policy of the Prussian Government towards Roman Catholic Education and Roman Catholicism with that of the English Government in Ireland. Crown 8vo. 6*s*.

Canon KINGSLEY'S WESTMINSTER SERMONS. 8vo. 10s. 6d.

These Sermons were preached either at Westminster Abbey or at one of the Chapels Royal. Their subjects are:—The Mystery of the Cross—The Perfect Love—The Spirit of Whitsuntide—Prayer—The Deaf and Dumb—The Fruits of the Spirit—Confusion—The Shaking of the Heavens and the Earth—The Kingdom of God—The Law of the Lord—God the Teacher—The Reasonable Prayer—The One Escape—The Word of God—I—The Cedars of Lebanon—Life—Death—Signs and Wonders—The Judgments of God—The War in Heaven—Noble Company—De Profundis—The Blessing and the Curse—The Silence of Faith—God and Mammon—The Beatific Vision.

WARNINGS AGAINST SUPERSTITION: in Four Sermons for the Day. By the Rev. J. LLEWELYN DAVIES, M.A., Rector of Christ Church, St. Marylebone. Extra fcap. 8vo. 2*s*. 6*d*.

YU-PE-YA'S LUTE; a Chinese Tale in English Verse. By Augusta Webster. Extra fcap. 8vo, price 3*s*. 6*d*.

New Edition, Crown 8vo, 7s. 6d.

A PLEA for PEASANT PROPRIETORS: with the Outlines of a Plan for their Establishment in Ireland. By W. T. Thornton, C.B., Author of "A Treatise on Labour," &c.

A FRENCH GRAMMAR based on PHILOLOGICAL PRINCIPLES. By Hermann BREYMANN, Lecturer on French Language and Literature at Owens College, Manchester. Extra fcap. 8vo, 4*s*. 6*d*.

RULES and EXAMPLES in ALGEBRA. By the Rev. T. Dalton, M.A., Assistant-Master at Eton. Part I. 18mo, 2*s*.

FIRST LESSONS in the PRINCIPLES of COOKING. By Lady Barker, Author of "Stories About:—" &c. 18mo, 1*s*.

New Volume of "Science Class Books."

STEAM: an Elementary Treatise. By John Perry, B.E., late Lecturer in Physics at Clifton College. With numerous Illustrations, Examples, and Exercises. 18mo, 4*s*. 6*d*.

PARALLEL EXTRACTS. Arranged for Translation into English and Latin, with Notes on Idioms. By J. E. NIXON, M. A., Classical Lecturer, King's College, London. Part I. Historical and Epistolary. This day, in crown 8vo, price 3*s*. 6*d*.

ATTIC PRIMER. Arranged for the use of Beginners. By J. Wright, M.A., late Head Master of Sutton Coldfield School. This day in extra fcap. 8vo, price 4*s*. 6*d*.

MACMILLAN AND CO., London.

New Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR JULY 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF JULY NUMBER—Our Illustrations:—1. "Thomas Carlyle," by J. D. Crittenden. 2. "Mother and Child," by W. Cave Thomas. 3. "Queen Elizabeth appointing her Successor," by R. Smirke, R.A.—The Exhibitions.—The Decoration of St. Paul's.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

Just Published. 8vo. Price 14s.

A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS;

OR, ORGANIC CHEMISTRY.

By C. SCHORLEMMER, F.R.S.,

LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.

"Nor is Mr. Schorlemmer appreciated by the profession for his experimental researches only; his fame is even more widely spread by his 'Manual of Organic Chemistry.' This is one of the favourite works from which the present generation of young chemists derive their information. Having myself to teach a large class of students, I have continuous opportunities of recommending this work and of observing the benefit derived from this recommendation."—PROF HOFMANN.

London: MACMILLAN AND CO.

IN THE PRESS.

ISMAILÏA

A NARRATIVE OF

THE EXPEDITION TO CENTRAL AFRICA

FOR THE SUPPRESSION OF

THE SLAVE TRADE.

ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.

By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,

Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.

MACMILLAN & CO., LONDON.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr. Lankester, September 30, 1867, Dr Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10s and upwards. Portable Filters on this system, £1 5s to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham, by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s. 6d. and 21s each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,

157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2d.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, July 2, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

NO. 245, VOL. 10] THURSDAY, JULY 9, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office

[All Rights are Reserved

BRITISH ASSOCIATION for the ADVANCEMENT OF SCIENCE,

(London Office, 22, Albemarle Street, London)

ROOM FOR THE EXHIBITION OF SPECIMENS, APPARATUS, &c.

A Room, under the control of a Committee appointed by the Council of the Association, will be provided for the Exhibition of Apparatus and Specimens in *illustration of Papers* communicated to the Sections at the Belfast Meeting, which will commence on August 19

Cases will be provided for protecting delicate objects

The Committee hope that Members will avail themselves of this opportunity of bringing under the notice of the Association new apparatus, chemical products, and new or important geological and biological specimens

G. GRIFFITH, M A.,
Assistant General Secretary, Harrow.

TWO SCHOLARSHIPS and an EXHIBITION in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A B. SHEPHERD, M.B.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F R.S ; Dr. Frankland, F R S. ; Dr. Roscoe, F.R.S., Dr. Angus Smith, F.R.S ; Dr. Tyndall, F.R.S , Dr. Voelcker, F.R.S. ; Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

MATHEMATICS and PHYSICS.—Mr. F. HUME TALBOT, M.A , late Junior Student of Christ Church, Oxford, First-Class in Mathematics and Natural Science, receives a few PUPILS, in a country home, and prepares them for the Army and Military Colleges, the Universities and the Scientific Professions For further particulars apply to Mr. F. H. Talbot, Speen, Newbury, Berks.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted —Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W

PROFESSORSHIP IN BIOLOGY.

DURHAM UNIVERSITY COLLEGES of MEDICINE and PHYSICAL SCIENCE, Newcastle-upon-Tyne —It is proposed to establish a Chair of Biology combined with Physiology, in connection with the above Institutions, in October next Salary £450, with a portion of fees Candidates for the office are invited to apply (with testimonials) to Theo Wood Bunning, Secretary to the College of Physical Science, Newcastle, before the 15th August next, from whom full particulars as to duties, &c , may be obtained

---

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY, 1841–1872, is now ready, including both Authors Names and Subjects It may be obtained by Fellows at the Society's Rooms, price 5s., by post 5s 4d , and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1s.

EGGS of LAMPERN or of LAMPREY.—A Naturalist is desirous of obtaining, either this year or next, a large supply of the above for scientific investigation. He would feel deeply indebted to any person who would enable him to secure a supply, and is prepared to go to an expense of several pounds Suggestions and advice addressed as below will be very welcome —E Ray Lankester, Exeter College, Oxford.

SCIENCE TUITION by CORRESPONDENCE.—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope Pupils will have the use of a large Scientific Library, Apparatus, &c —For Terms, address 'H.,' care of Macmillan & Co., 29, Bedford Street, Strand, London, W C

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities

---

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W C

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education Highest References can be given.—Address, M.A H , care of the Publishers of NATURE, 29, Bedford Street Covent Garden, W C.

TO NATURALISTS and GEOLOGISTS.

—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS. (See Advertisement in NATURE of June 18th) For particulars of these Collections address Fredc. Collingwood, Esq., F.G.S., 4, St. Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."

July 8th.

GEOLOGY OF WEYMOUTH AND PORTLAND.

Numerous Illustrations.

With Notes on the Natural History of the Coast and Neighbourhood.

Price 3s. 6d., or with Geological Map, 5s.

By R. DAMON, F.G.S.

Weymouth.

TO BE SOLD.—A Collection of British Bird-skins, Eggs, and Insects in Oak Cabinets.—For further particulars apply to "Oologist," care of Editor of NATURE, 29, Bedford Street, Strand, London, W.C.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X.Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

WANTED to PURCHASE, a CLASSIFIED COLLECTION of BRITISH BIRDS' EGGS. Must all be well authenticated.—Apply, stating terms, to E. E. B., care of Messrs. MACMILLAN and Co., Bedford Street, Strand, W.C.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

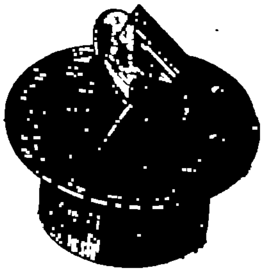
ESTABLISHED 1843.

FOR MICROSCOPE DRAWING

THE

NEUTRAL TINT CAMERA

Is the easiest and Best, and can be fitted to any Microscope Eye-piece by sending Cap for size per post. Price 7s. 6d. Post Orders payable at Great Portland Street.



CHAS. COLLINS,

Maker to the Government,
157, GREAT PORTLAND ST.
LONDON, W.

SOLE MAKER OF THE
"HARLEY"
BINOCULAR MICROSCOPE.

ILLUSTRATED CATALOGUE OF MICROSCOPES and all Apparatus free per post on application.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 "	One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.	Flows easily from the Pen.
Does not corrode Steel Pens.	Blotting-paper may be applied at the moment of writing.
Is cleanly to use, and not liable to Blot.	

TO BE HAD OF ALL STATIONERS.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s., Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

THE LINGUIST,

AND

EDUCATIONAL REVIEW.

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and News-vendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 10*s* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, S.W.

MACMILLAN'S MAGAZINE.

No. 177. FOR JULY.

PRICE 1s.

CONTAINS—

1.—"Slavery and the Slave Trade." By Sir Samuel White Baker, Pasha, M.A., F.R.S., F.R.G.S., &c.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XIV.—XVI
3.—"The Shadow of Death" By Sidney Colvin.
4.—"Michelet." By Gabriel Monod, Directeur à l'École des Hautes Études, Paris.
5.—"The Caliph's Draught" By Edwin Arnold.
6.—"The Convent of San Marco" I. The Painter.
7.—"The Persian Poet Hâfiz." By Prof. Cowell.
8.—"A Curious Product"
9.—"Requiescat." By J. W. Hales.
10.—"The Esthonian Hercules." By John Oxenford.
11.—Two Addresses by the Dean of Westminster. I. John Bunyan. II. Arnold and Rugby.

MACMILLAN & CO., London.

PRICE EIGHTEENPENCE.

THE PRACTITIONER:

A Monthly Journal of

THERAPEUTICS.

Edited by FRANCIS E. ANSTIE, M.D., F.R.C.P., Senior Assistant Physician to Westminster Hospital, and Lecturer on Materia Medica in Westminster Hospital School.

No. LXXIII. for JULY 1874, Contains—

Original Communications:—

W. B. CHEADLE, M.D. F.R.C.P.—"Acne Rosacea"

ROBERTS BARTHOLOW, M.A. M.D.—"On the Deep Injection of Chloroform for the Relief of Tic Douloureux"

Dr. ANSTIE.—"Final Experiments on the Elimination of Alcohol from the Body."

Reviews, Clinic of the Month, Extracts from British and Foreign Journals, Correspondence.

DEPARTMENT OF PUBLIC HEALTH

The Sanitary Laws Amendment Bill.—The Registration of Births and Deaths Bill.—Dr. Buchanan on Enteric Fever in Caius College, Cambridge.—Fonssagrives on the Hygiene of Towns.

MACMILLAN & CO., 29 & 30, Bedford Street, Covent Garden, London.

THE JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and Interesting Scientific Facts

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co, Stationers' Hall Court.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible])

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests

Subscription, 16*s* 6*d.* per annum, post free, dating from any quarter-day. Single Copies, 1*s.* each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

SCOTTISH PROVIDENT INSTITUTION,

EDINBURGH: 6, St. Andrew Square. LONDON: 18, King William Street, E.C.

ITS ADVANTAGES over other offices are:—

A larger immediate assurance for the same premium, with the prospect to good lives of eventually receiving very considerable additions.

Thus £1,200 or £1,250 may be secured at once for the premium usually charged for £1,000 only; and policies originally for, say, £1,000, have been increased to £1,170, £1,450, £1,600, and in some cases have been doubled.

FINANCIAL POSITION.

The Fund, accumulated entirely from the premiums, exceeds £2,250,000. Notwithstanding its low rates, no Office of the same age (Established 1837) has so large a Fund, or shows so large an increase from year to year.

This day is published.

MANUAL OF BOTANY,

ANATOMICAL AND PHYSIOLOGICAL.

FOR THE USE OF STUDENTS.

By **ROBERT BROWN, M.A., Ph.D., F.L.S., F.R.G.S.,** &c.

Lecturer on Botany, Edinburgh.

360 Illustrations. Crown 8vo, 12s. 6d.

WILLIAM BLACKWOOD & SONS, Edinburgh and London.

Just Published. 8vo. Price 14s.

A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS; OR, ORGANIC CHEMISTRY.

By C. SCHORLEMMER, F.R.S.,

LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.

"Nor is Mr. Schorlemmer appreciated by the profession for his experimental researches only; his fame is even more widely spread by his 'Manual of Organic Chemistry.' This is one of the favourite works from which the present generation of young chemists derive their information. Having myself to teach a large class of students, I have continuous opportunities of recommending this work and of observing the benefit derived from this recommendation."—PROF HOFMANN.

London: MACMILLAN AND CO.

This day, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34s.

ELEMENTS OF METALLURGY.

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By **J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.**

Ancien Élève de l'École des Mines, Paris; Author of "Mining and Metallurgy of Gold and Silver," &c.

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

A FEW ARTIST'S PROOFS

OF

THE PORTRAIT OF CHARLES DARWIN, F.R.S.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,

PRICE 5s. EACH,

OR THROUGH ANY BOOKSELLER.

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES, By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

NEW EDITION OF SIR W. R. GROVE'S WORK ON THE PHYSICAL FORCES.

Now ready, in 1 vol 8vo. cloth, price 15s.

THE CORRELATION OF PHYSICAL FORCES. Sixth Edition, with other Contributions to Science. By the Hon. Sir W. R. Grove, M.A. F.R.S., one of the Judges of the Court of Common Pleas.

London: LONGMANS & CO., Paternoster Row.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

Works by Francis Galton, F.R.S.

METEOROGRAPHICA, or Methods of Mapping the Weather. Illustrated by upwards of 600 Printed Lithographic Diagrams. 4to, 9*s.*

As Mr. Galton entertains strong views on the necessity of meteorological charts and maps, he determined, as a practical proof of what could be done, to chart the area of Europe, so far as meteorological stations extend, during one month, viz. the month of December 1861. Mr. Galton got his data from authorities in every part of Britain and the Continent, and on the basis of these has here drawn up nearly a hundred different maps and charts, showing the state of the weather all over Europe during the above period.

HEREDITARY GENIUS: An Inquiry into its Laws and Consequences. Demy 8vo, 12*s.*

"A most able and most interesting book."—*Times.* "We know, through the admirable labours of Mr. Galton, that Genius tends to be inherited."—Darwin's "Descent of Man," vol. i. p. 3.

MACMILLAN & CO., LONDON.

An INTRODUCTION to the OSTEOLOGY

of the MAMMALIA. Being the substance of the Course of Lectures delivered at the Royal College of Surgeons of England in 1870. By W. H. FLOWER, F.R.S., F.R.C.S., Hunterian Professor of Comparative Anatomy and Physiology. With numerous Illustrations. Globe 8vo, 7*s.* 6*d.*

Although the present work contains the substance of a Course of Lectures the form has been changed, so as the better to adapt it as a handbook for students. Theoretical views have been almost entirely excluded; and while it is impossible in a scientific treatise to avoid the employment of technical terms, it has been the author's endeavour to use no more than absolutely necessary, and to exercise due care in selecting only those that seem most appropriate, or which have received the sanction of general adoption. With a very few exceptions the illustrations have been drawn expressly for this work from specimens in the Museum of the Royal College of Surgeons.

MACMILLAN & CO., LONDON.

TISLEY'S
PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on ...	£12	0	0
Reflectors for projecting the Figures on the Screen ...	2	12	6
N B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

HOLLOWAY'S OINTMENT and PILLS.

—"Experience before authority"—For nearly a third of a century have these remedies stood in the foremost rank for overcoming ulcers, sores, swellings, rashes, and all descriptions of skin diseases At first the faculty denounced these medicaments, but the experience of sufferers soon overthrew all interested opposition. Those whom Holloway's medicine had cured told other invalids the benefits they had derived from their use, these in their turn tried them, and found equally satisfactory results. Old and new stores of knowledge were ransacked to discover the surest and simplest method of meeting and conquering sickness—the issue was the invention of Holloway's Curatives, which the testimony of patients universally indorses as indisputable defences against disease.

NEW BOOKS.

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the Orders of Her Majesty's Government; with Incidental Notices of the Countries through which the Lines pass. By Colonel Sir FREDERIC GOLDSMID, C.B. K.C.S.I., late Director of the Government Indo-European Telegraph. With numerous Illustrations and Maps, 8vo. [Immediately.

ESSAYS and ADDRESSES, by PROFESSORS and LECTURERS of Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. 8vo, 14*s*. [This day.

Among the contributors to this volume are the following:—The Duke of Devonshire, K.G. F.R.S., Prof. Greenwood (Principal), Prof. Roscoe, F.R.S., Prof. Balfour Stewart, F.R.S., Prof. Williamson, F.R.S., Prof. Gamgee, F.R.S., Prof. Bryce, D.C.L., Prof. Jevons, F.R.S., &c.

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices, by B. H. KENNEDY, D.D., Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6*s*. [Just ready.

HORÆ HELLENICÆ. Essays and Discussions on some Important Points of Greek Philology and Antiquity. By JOHN STUART BLACKIE, F.R.S.E., Professor of Greek in the University of Edinburgh. 8vo, 12*s*. [This day.

SOME LEADING PRINCIPLES of POLITICAL ECONOMY newly EXPOUNDED. By J. E. CAIRNES, M.A., Emeritus Professor of Political Economy in University College, London. 8vo, 14*s*. [This day.

"It is with great pleasure that we welcome another contribution to political economy from the ablest living representative of the school of Ricardo and Mill."—*Saturday Review*.

"The most important part of this volume is that which deals with cost of production and of value as determined by cost. It is on this subject that Prof. Cairnes has rendered the most signal service to the progress of economic science; and, if we mistake not, his investigations will mark an era in the history of political economy as distinct as, and scarcely less important than, those connected with the names of Ricardo, Malthus, and Mill."—*Athenæum*.

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor MASSON. Crown 8vo. [Immediately.

THOUGHTS on REVELATION. By JOHN M'LEOD CAMPBELL, D.D. Second Edition, crown 8vo, 5*s*. [This day.

BIRDS: their Cages and their Keep. By Lady DICKEY. With Illustrations. Crown 8vo. [Shortly.

NEW VOLUME OF "*NATURE*" SERIES

The TRANSIT of VENUS. By George FORBES, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With numerous Illustrations, crown 8vo. [Shortly.

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER of PHYSIOLOGY. By Michael FOSTER, F.R.S. With Illustrations, 18mo. [Shortly.

NEW VOLUME OF "THE GOLDEN TREASURY SERIES."

SCOTTISH SONG.—A Selection of the Choicest LYRICS of SCOTLAND. Compiled and Arranged, with Brief Notes, by MARY CARLYLE AITKEN. 18mo, 4*s*. 6*d*. [This day.

Twelfth Edition, Revised.

NOTES on the PARABLES of OUR LORD. By R. CHENEVIX TRENCH, D.D., Archbishop of Dublin. 8vo, 12*s*. [This day.

A NEW FRENCH DICTIONARY.

A COMPENDIOUS DICTIONARY of the FRENCH LANGUAGE (French-English and English-French). Followed by a List of the Principal Diverging Derivations, and preceded by Chronological and Historical Tables. By GUSTAVE MASSON, Assistant-Master and Librarian, Harrow School. Square half bound, 6*s*. [This day.

This volume, though cast in the same form as other dictionaries, has several distinctive features which increase its value for the student. In the French-English part, etymologies, founded on the researches of Messrs. Littré, Scheler, and Brachet, are given. The list of diverging derivations, at the end of the volume, will be very useful to those who are interested in tracing the various developments of original Latin words. But that which makes it almost indispensable to students of the political and literary history of France, is to be found at the beginning of the work, where M. Masson has drawn up clear and complete tables of historical events, viewed in connection with the developments of literature and language, between the death of Charlemagne, 814 A.D., and that of Louis Philippe, 1850. These tables are illustrated by remarks on the various social moods of which the works produced were the expression. Appended also is a list of the principal Chronicles and Memoirs on the History of France which have appeared up to the present time; the French Republican Calendar, compared with the Gregorian; and a Chronological List of the principal French Newspapers published during the Revolution and the First Empire. We feel sure that all who study this work will allow that the author has signally overcome the lexicographer's natural tendency to dryness. As a dictionary, it is unusually copious, and as a book remarkably handy.

THIRD AND CHEAPER EDITION, SOMEWHAT ABRIDGED.

JOHN COLERIDGE PATTESON'S LIFE. By CHARLOTTE M. YONGE, Author of "The Heir of Redclyffe." With Two Portraits, engraved by Jeens. 2 vols. crown 8vo, 12*s*. [This day.

"Miss Yonge's book is in one respect a model biography. It is made up almost entirely of Patteson's own letters. Aware that he had left his home for once and for all, his correspondence took the shape of a diary, and as we read on we come to know the man, and to love him almost as if we had seen him."—*Athenæum*.

"Such a life, with its grand lessons of unselfishness, is a blessing and an honour to the age in which it is lived. The biography cannot be studied without pleasure and profit; and, indeed, we should think little of the man who did not rise from the study of it better and wiser. Neither the Church nor the Nation which produces such sons need ever despair of its future."—*Saturday Review*.

Nearly ready, No. X. of

The JOURNAL of PHILOLOGY. Edited by W. G. CLARK, M.A., Fellow of Trinity College; J. E. B. MAYOR, M.A., Fellow of St John's College; and W. ALDIS WRIGHT, M.A., Trinity College, Cambridge.

Contents:—

On Glossology (continued). The late Professor Grote.
On the Word [illegible] in the Equites of Aristophanes, v. 89. W. H. Thompson.
The Classification of Conditional Sentences in Greek Syntax. W. W. Goodwin.
On the Interpretation of Plato, Timæus, p. 40 C. L. Campbell.
Platonica. W. H. Thompson.
On the Place of a Fragment of Æschylus. No. 437 Dindorf, 124 Nauck. D. C. Tovey.
On the Existence of Written Histories in the Time of Thucydides (B.C. 470–400). F. A. Paley.
The [illegible] of Socrates. Henry Jackson.
Proposed Emendations of the Text of Origen against Celsus. Books I., II. III., IV. William Selwyn.
On the Newly-Edited Poems of Dracontius. R. Ellis.
On two Passages of Statius's Silvæ. R. Ellis.
On Sulpiciæ Satira. R. Ellis.
On the Sixth Letter of Isokrates. R. C. Jebb.
On the Homeric Words [illegible]. F. A. Paley.
On the Etymology of certain Words in English terminating in *SH* and *SK*. Eiríkr Magnússon.
Love Amor. Love Nought. Eiríkr Magnússon.
Catullus's 54th Poem. H. A. J. Munro.

MACMILLAN & CO., LONDON.

CLARENDON PRESS PUBLICATIONS

Now ready, in 4to, cloth, price 3*l.* 7*s.*

An ICELANDIC-ENGLISH DICTIONARY, Based on the M.S. Collections of the late RICHARD CLEASBY. Enlarged and completed by GUDBRAND VIGFUSSON, M.A. With an Introduction and Life of CLEASBY by G. WEBBE DASENT, D.C.L. (Part III., completing the work, 25*s.*)

"The greatest help to English Philology that has yet been published."—*Times.*

The LOGIC of HEGEL. Translated from the Encyclopædia of the Philosophical Sciences. By W. WALLACE, Fellow and Tutor of Merton College. With Prolegomena. 8vo, 14*s.*

The THIRD BOOK of ST. IRENÆUS, BISHOP of LYONS, against HERESIES. With Short Notes and Glossary by H. DEANE, B.D. Crown 8vo, 5*s.* 6*d.*

NEW VOLUMES OF THE CLARENDON PRESS SERIES.

"Such Manuals, so admirable in matter, arrangement, and type, were never before given to the world at the same moderate price."—*Spectator.*

The WORKS of HORACE. Edited with Introductions, Essays, and English Notes. By E. C. WICKHAM, M.A., Head Master of Wellington College. Vol. I. Odes and Epodes. 8vo, 12*s.*

COWPER'S The TASK. With Tirocinium and Selections from the Minor Works. Edited, with Life and Notes, by H. T. GRIFFITH, M.A. Extra fcap. 8vo, 3*s.*

SELECT TITLES, from the DIGEST of JUSTINIAN. Edited by T. E. Holland, B.C.L. and C. L. SHADWELL, B.C.L. Part I. Introductory Titles. 8vo, 2*s.* 6*d.*

A CONSTITUTIONAL HISTORY of ENGLAND. Its Origin and Development. By W. STUBBS, M.A., Regius Professor of Modern History at Oxford. Vol. I. Crown 8vo, 12*s.*

GENEALOGICAL TABLES, Illustrative of MODERN HISTORY. By Hereford B. GEORGE, M.A. F.R.G.S. 4to, 12*s.*

Oxford: Printed at the "Clarendon Press," and Published by MACMILLAN & CO., London, Publishers to the University.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s.*, 21*s.*, 26*s.* 6*d.*, and 31*s.* 6*d.*
,, Double ,, 31*s.* 6*d.*, 42*s.*, and 52*s.* 6*d.*
,, Umbilical ,, 42*s.* and 52*s.* 6*d.*
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s.* 6*d.*, 7*s.* 6*d.*, 10*s.*, and 16*s.* each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

THE *ZOOLOGIST.*

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING

and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle.—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and meat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST.

A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading.

Price 6*d.* per month, or 5*s.* per annum, Post Free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each

PREPARING FOR PUBLICATION (*Second Edition*):

THE MINERAL CONSTITUENTS REMOVED FROM AN ACRE OF SOIL

by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

E. DENT & CO., 61, Strand, & 34, Royal Exchange.
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), **COMPASSES, &c.,**
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

New Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.
FOR JULY 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF JULY NUMBER—Our Illustrations:—1. "Thomas Carlyle," by J. D. Crittenden. 2. "Mother and Child," by W. Cave Thomas. 3. "Queen Elizabeth appointing her Successor," by R. Smirke, R.A.—The Exhibitions:—The Decoration of St. Paul's.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

IN THE PRESS.

ISMAILÏA

A NARRATIVE OF
THE EXPEDITION TO CENTRAL AFRICA
FOR THE SUPPRESSION OF
THE SLAVE TRADE.
ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.
By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,

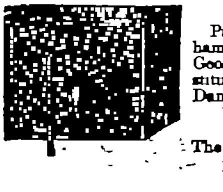
Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.

MACMILLAN & CO., LONDON.

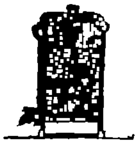
THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867 Also Testimonials from Dr. Hassall, September 23, 1863; Dr Lankester, September 10, 1867; Dr Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.



Portable Cistern Filter.



Price £1 10*s* and upwards Portable Filters on this system, £1 5*s*. to £3

Patronised and used by Her Majesty the Queen, at Osborne, by H.R.H. the Prince of Wales, at Sandringham; by H.R.H the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10*s* 6*d*. and 21*s*. each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4*s*. 6*d* to 6*s*. each. Household and Fancy Filters from 12*s*. 6*d*.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.
Read "Water: its Impurities and Purification," price, per post, 2*d*

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & CO. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, July 9, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

NO. 246, VOL. 10] THURSDAY, JULY 16, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved

TWO SCHOLARSHIPS and an EXHIBITION in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A B SHEPHERD, M B.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F R S.; Dr. Roscoe, F R.S; Dr. Angus Smith, F.R.S; Dr. Tyndall, F R.S; Dr. Voelcker, F R.S.; Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W

PROFESSORSHIP IN BIOLOGY.

DURHAM UNIVERSITY COLLEGES of MEDICINE and PHYSICAL SCIENCE, Newcastle-upon-Tyne.—It is proposed to establish a Chair of Biology combined with Physiology, in connection with the above Institutions, in October next. Salary £450, with a portion of fees. Candidates for the office are invited to apply (with testimonials) to Theo Wood Bunning, Secretary to the College of Physical Science, Newcastle, before the 15th August next, from whom full particulars as to duties, &c., may be obtained.

CHEMICAL SOCIETY

An INDEX to the JOURNAL of the CHEMICAL SOCIETY, 1841–1872, is now ready, including both Authors Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5s., by post 5s 4d, and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1s

---

PRIESTLEY MEMORIAL, BIRMINGHAM.

The STATUE of Dr. PRIESTLEY will be UNVEILED on the 1st of August, and will be presented to the Town by Professor HUXLEY on behalf of the subscribers

Professor Huxley will afterwards deliver an address in the Town Hall

Subscribers who have not received tickets of admission to the ceremony should apply at once to Mr. C. J. Woodward, Midland Institute, Birmingham

---

TO NATURALISTS and GEOLOGISTS.—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS. (See Advertisement in NATURE of June 18th) For particulars of these Collections address Fredc. Collingwood, Esq., F G S, 4, St Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND"

July 8th.

EGGS of LAMPERN or of LAMPREY.—A Naturalist is desirous of obtaining, either this year or next, a large supply of the above for scientific investigation. He would feel deeply indebted to any person who would enable him to secure a supply, and is prepared to go to an expense of several pounds. Suggestions and advice addressed as below will be very welcome.—E Ray Lankester, Exeter College, Oxford.

TO BE SOLD CHEAP, a Small Collection of valuable and unique FOSSILS, &c., for £3. Apply, W. B Talent, Bookseller and Stationer, Broomhill Street, Sheffield

---

MATHEMATICS and PHYSICS.—Mr. F. HUME TALBOT, M.A., late Junior Student of Christ Church, Oxford, First-Class in Mathematics and Natural Science, receives a few PUPILS, in a country home, and prepares them for the Army and Military Colleges, the Universities and the Scientific Professions. For further particulars apply to Mr F H Talbot, Speen, Newbury, Berks.

SCIENCE TUITION by CORRESPONDENCE.—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope. Pupils will have the use of a large Scientific Library, Apparatus, &c.—For Terms, address H., care of Macmillan & Co., 29, Bedford Street, Strand, London, W C

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W C.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens — — — One Guinea.
British Fossils—100 „ — — — One Guinea.

Collections and Specimens of

British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV From 10s each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals
Monocular, £5; Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from $\frac{1}{4}$ to $\frac{1}{16}$ inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in, 14s.; 4½ in, 17s.; 6 in, in Wooden Case, 10s, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c —Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut, Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d*., or prepaid, 15*s*. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S , Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c ; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d*. per Copy. It may also be had direct from the Office at 5*s*. for a Quarter, 9*s*. 9*d*. for a Half-year, and 10*s*. 6*d*. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d*.

37, Southampton Street, Covent Garden, S.W.

PRICE EIGHTEENPENCE.

THE PRACTITIONER: A Monthly Journal of THERAPEUTICS.

Edited by FRANCIS E. ANSTIE, M D., F.R.C.P., Senior Assistant Physician to Westminster Hospital, and Lecturer on Materia Medica in Westminster Hospital School.

No. LXXIII. for JULY 1874, *Contains—*

Original Communications:—

W. B. CHEADLE, M D. F.R.C.P —"Acne Rosacea."

ROBERTS BARTHOLOW, M.A. M.D.—"On the Deep Injection of Chloroform for the Relief of Tic Douloureux"

Dr. ANSTIE.—"Final Experiments on the Elimination of Alcohol from the Body."

Reviews, Clinic of the Month, Extracts from British and Foreign Journals, Correspondence.

DEPARTMENT OF PUBLIC HEALTH.

The Sanitary Laws Amendment Bill.—The Registration of Births and Deaths Bill —Dr. Buchanan on Enteric Fever in Caius College, Cambridge. —Fonssagrives on the Hygiene of Towns.

MACMILLAN & CO., 29 & 30, Bedford Street, Covent Garden, London.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations. Conducted by J W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7*s*. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B —Communications, &c., should be sent to the Editors at the above address.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS :—W. BEST & SONS, Henrietta Street, Cavendish Square.

BRYANT & MAY'S MATCHES.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided, a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s*., 21*s*., 26*s*. 6*d*., and 31*s*. 6*d*.
,, Double ,, 31*s*. 6*d*., 42*s*., and 52*s*. 6*d*.
,, Umbilical ,, 42*s* and 52*s*. 6*d*.
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking Price 4*s*. 6*d*., 7*s*. 6*d*., 10*s*., and 16*s*. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

HOLLOWAY'S PILLS.—These Pills are more efficacious in strengthening a debilitated constitution than any other medicine in the world , they repress most human diseases, redress all bodily wrongs, and spare much unmerited suffering Persons of a nervous habit of body, and all who labour under weak digestive organs or liver complaints, should lose no time in giving these admirable Pills a fair trial. Coughs, colds, asthma, or shortness of breath, are also within the range of the curative powers of this very remarkable medicine. The cures effected by these Pills are not superficial or temporary, but complete and permanent. They are as mild as they are efficacious, and may be given with confidence to delicate females and young children.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY, BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B, F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s*. post free in the United Kingdom) payable in advance to the publishers, Messrs. Renken and Co., Drury House, St. Mary-le-Strand, London, W C., of whom may be obtained the volume for 1873 (price 16*s* 6*d*. bound in cloth); also covers for the volume (price 1*s*.), and back numbers.

Now ready, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34s.

ELEMENTS OF METALLURGY.

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.

Ancien Elève de l'Ecole des Mines, Paris

"The value of the work is almost inestimable."—*Mining Journal.*

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

IN THE PRESS.

A NEW WORK BY SIR SAMUEL BAKER.

ISMAILIA

A NARRATIVE OF

THE EXPEDITION TO CENTRAL AFRICA

FOR THE SUPPRESSION OF

THE SLAVE TRADE.

ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.

By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,

Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.

MACMILLAN & CO., LONDON.

THE LINGUIST;

AND

EDUCATIONAL REVIEW.

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

NEW EDITION OF SIR W. R. GROVE'S WORK ON THE PHYSICAL FORCES.

Now ready, in 1 vol. 8vo. cloth, price 15s.,

THE CORRELATION OF PHYSICAL FORCES. Sixth Edition, with other Contributions to Science. By the Hon. Sir W. R. Grove, M.A. F.R.S., one of the Judges of the Court of Common Pleas.

London: LONGMANS & CO., Paternoster Row.

EDUCATION AT ZURICH.—Mr. DE BAUDISS, formerly one of the Assistant Masters at Wellington College, receives a limited number of PUPILS, and will have vacancies in October. The house is healthily situated, and the style of living is arranged to suit English habits. Mr. de Baudiss is assisted by competent Masters, and is able to offer, in addition to French and German and the usual subjects of a liberal education, special facilities for the study of Physical and Mechanical Science. Advanced Pupils have the opportunity of attending the Lectures of the Polytechnic School, on Engineering, Agriculture, and other branches of Applied Science.—For terms and references apply to F. de Baudiss, Wiesenstrasse, Seefeld, Zurich.

This day, in 8vo, price 14s, with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

Contents:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle. —*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and meat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading.

Price 6*d.* per month, or 5*s.* per annum, Post Free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

Preparing for Publication (*Second Edition*).

THE MINERAL CONSTITUENTS RE- MOVED FROM AN ACRE OF SOIL by an Average Crop of Wheat, Oats, Barley, Turnips, &c; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

DIARY OF SOCIETIES.

LONDON

FRIDAY, JULY 17.

MEDICAL MICROSCOPICAL SOCIETY, at 8.—On Mycetoma: Jabez Hogg

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s*. 6*d*.

Cloth Cases for binding all the volumes, price 1*s*. 6*d*. each.

Reading Cases to hold 26 numbers, price 2*s*. 6*d*.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

TISLEY'S
PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	[illegible]	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5	5	0

TISLEY AND SPILLER,
OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 *PAGES QUARTO*,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

Third Edition, royal 8vo, cloth extra, 21*s*.

SPECTRUM ANALYSIS. By Professor ROSCOE, F.R.S. With Appendices, Engravings, Maps, and Chromolithographs.

"The illustrations—no unimportant part of a book on such a subject—are marvels of wood-printing, and reflect the clearness which is the distinguishing merit of Mr. Roscoe's explanations."—*Saturday Review*.

"The lectures themselves furnish a most admirable elementary treatise on the subject, whilst by the insertion in appendices to each lecture of extracts from the most important published memoirs, the author has rendered it equally valuable as a text-book for advanced students."—*Westminster Review*.

MACMILLAN & CO., LONDON.

Just Published. 8vo. Price 14*s*.

A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS; OR, ORGANIC CHEMISTRY.

By C. SCHORLEMMER, F.R.S.,

LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.

"Nor is Mr. Schorlemmer appreciated by the profession for his experimental researches only; his fame is even more widely spread by his 'Manual of Organic Chemistry.' This is one of the favourite works from which the present generation of young chemists derive their information. Having myself to teach a large class of students, I have continuous opportunities of recommending this work and of observing the benefit derived from this recommendation."—PROF. HOFMANN.

London: MACMILLAN AND CO.

NEW BOOKS.

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the Orders of Her Majesty's Government, with Incidental Notices of the Countries through which the Lines pass. By Colonel Sir FREDERIC GOLDSMID, C.B. K.C.S.I., late Director of the Government Indo-European Telegraph. *With numerous Illustrations and Maps*, 8vo. [Immediately.

ESSAYS and ADDRESSES, by PROFESSORS and LECTURERS of Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873 8vo, 14*s*. [This day.

Among the contributors to this volume are the following:—The Duke of Devonshire, K.G. F.R.S., Prof. Greenwood (Principal), Prof. Roscoe, F.R.S., Prof. Balfour Stewart, F.R.S., Prof. Williamson, F.R.S., Prof. Gamgee, F.R.S., Prof. Bryce, D.C.L., Prof. Jevons, F.R.S., &c.

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices, by B. H. KENNEDY, D.D., Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6*s*. [Just ready.

HORÆ HELLENICÆ. Essays and Discussions on some Important Points of Greek Philology and Antiquity. By JOHN STUART BLACKIE, F.R.S.E., Professor of Greek in the University of Edinburgh. 8vo, 12*s*. [This day.

SOME LEADING PRINCIPLES of POLITICAL ECONOMY newly EXPOUNDED. By J. E. CAIRNES, M.A., Emeritus Professor of Political Economy in University College, London. 8vo, 14*s*. [This day.

"It is with great pleasure that we welcome another contribution to political economy from the ablest living representative of the school of Ricardo and Mill."—*Saturday Review.*

"The most important part of this volume is that which deals with cost of production and of value as determined by cost. It is on this subject that Prof. Cairnes has rendered the most signal service to the progress of economic science; and, if we mistake not, his investigations will mark an era in the history of political economy as distinct as, and scarcely less important than, those connected with the names of Ricardo, Malthus, and Mill."—*Athenæum.*

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor MASSON, Crown 8vo. [Immediately.

THOUGHTS on REVELATION. By JOHN M'LEOD CAMPBELL, D.D. Second Edition, crown 8vo, 5*s*. [This day.

BIRDS: their Cages and their Keep. By Lady DICKEY. With Illustrations. Crown 8vo. [Shortly.

NEW VOLUME OF "*NATURE* SERIES."

The TRANSIT of VENUS. By George FORBES, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With numerous Illustrations, crown 8vo. [Shortly.

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER of PHYSIOLOGY. By Michael FOSTER, F.R.S. With Illustrations, 18mo. [Shortly.

NEW VOLUME OF "THE GOLDEN TREASURY SERIES."

SCOTTISH SONG.—A Selection of the Choicest LYRICS of SCOTLAND. Compiled and Arranged, with Brief Notes, by MARY CARLYLE AITKEN. 18mo, 4*s*. 6*d*. [This day.

Twelfth Edition, Revised.

NOTES on the PARABLES of OUR LORD. By R. CHENEVIX TRENCH, D.D., Archbishop of Dublin. 8vo, 12*s*. [This day.

A NEW FRENCH DICTIONARY.

A COMPENDIOUS DICTIONARY of the FRENCH LANGUAGE (French-English and English-French). Followed by a List of the Principal Diverging Derivations, and preceded by Chronological and Historical Tables. By GUSTAVE MASSON, Assistant-Master and Librarian, Harrow School. Square half bound, 6*s*. [This day.

This volume, though cast in the same form as other dictionaries, has several distinctive features which increase its value for the student. In the French-English part, etymologies, founded on the researches of Messrs. Littré, Scheler, and Brachet, are given. The list of diverging derivations, at the end of the volume, will be very useful to those who are interested in tracing the various developments of original Latin words. But that which makes it almost indispensable to students of the political and literary history of France, is to be found at the beginning of the work, where M. Masson has drawn up clear and complete tables of historical events, viewed in connection with the developments of literature and language, between the death of Charlemagne, 814 A.D., and that of Louis Philippe, 1850. These tables are illustrated by remarks on the various social moods of which the works produced were the expression. Appended also is a list of the principal Chronicles and Memoirs on the History of France which have appeared up to the present time; the French Republican Calendar, compared with the Gregorian; and a Chronological List of the principal French Newspapers published during the Revolution and the First Empire. We feel sure that all who study this work will allow that the author has signally overcome the lexicographer's natural tendency to dryness. As a dictionary, it is unusually copious, and as a book remarkably handy.

THIRD AND CHEAPER EDITION, SOMEWHAT ABRIDGED.

JOHN COLERIDGE PATTESON'S LIFE. By CHARLOTTE M. YONGE, Author of "The Heir of Redclyffe." With Two Portraits, engraved by Jeens. 2 vols. crown 8vo, 12*s*. [This day.

"Miss Yonge's book is in one respect a model biography. It is made up almost entirely of Patteson's own letters. Aware that he had left his home for once and for all, his correspondence took the shape of a diary, and as we read on we come to know the man, and to love him almost as if we had seen him."—*Athenæum.*

"Such a life, with its grand lessons of unselfishness, is a blessing and an honour to the age in which it is lived: the biography cannot be studied without pleasure and profit; and, indeed, we should think little of the man who did not rise from the study of it better and wiser. Neither the Church nor the Nation which produces such sons need ever despair of its future."—*Saturday Review.*

Nearly ready, No. X. of

The JOURNAL of PHILOLOGY. Edited by W. G. CLARK, M.A., Fellow of Trinity College; J. E. B. MAYOR, M.A., Fellow of St. John's College; and W. ALDIS WRIGHT, M.A., Trinity College, Cambridge.

Contents:—

On Glossology (continued). The late Professor Grote.
On the Word [illegible] in the Equites of Aristophanes, v. 89. W. H. Thompson.
The Classification of Conditional Sentences in Greek Syntax. W. W. Goodwin.
On the Interpretation of Plato Timaeus, p. 40 C. L. Campbell.
Platonica. W. H. Thompson.
On the Place of a Fragment of Æschylus No. 437 Dindorf, 284 Nauck. D. C. Tovey.
On the Existence of Written Histories in the Time of Thucydides (B.C. 470–400). F. A. Paley.
The [illegible] of Socrates. Henry Jackson.
Proposed Emendations of the Text of Origen against Celsus. Books I., II. III., IV. William Selwyn.
On the Newly-Edited Poems of Dracontius. R. Ellis.
On two Passages of Statius's Silvæ. R. Ellis.
On Sulpiciæ Satira. R. Ellis.
On the Sixth Letter of Isokrates. R. C. Jebb.
On the Homeric Words [illegible]. F. A. Paley.
On the Etymology of certain Words in English terminating in *SH* and *SK*. Eiríkr Magnússon.
Love Amor. Love Nought. Eiríkr Magnússon.
Catullus's 54th Poem. H. A. J. Munro.

MACMILLAN & CO., LONDON.

MACMILLAN & CO.'S

GOLDEN TREASURY SERIES.

Uniformly Printed in 18mo., with Vignette Titles by Sir NOEL PATON, T. WOOLNER, W. HOLMAN HUNT, J. E. MILLAIS, ARTHUR HUGHES, &c. Engraved on Steel by JEENS. Bound in extra cloth, 4*s.* 6*d.* each volume. Also kept in morocco and calf bindings.

"*Messrs. Macmillan have, in their Golden Treasury Series, especially provided editions of standard works, volumes of selected poetry, and original compositions, which entitle this series to be called classical. Nothing can be better than the literary execution, nothing more elegant than the material workmanship.*"—British Quarterly Review.

The Golden Treasury of the Best Songs and Lyrical Poems in the English Language. Selected and arranged, with Notes, by FRANCIS TURNER PALGRAVE.

"*This delightful little volume, the Golden Treasury, which contains many of the best original lyric pieces and songs in our language, grouped with care and skill, so as to illustrate each other like the pictures in a well-arranged gallery.*"—Quarterly Review.

The Children's Garland from the best Poets. Selected and arranged by Coventry Patmore.

"*It includes specimens of all the great masters in the art of poetry, selected with the matured judgment of a man concentrated on obtaining insight into the feelings and tastes of childhood, and desirous to awaken its finest impulses, to cultivate its keenest sensibilities.*"—Morning Post.

The Book of Praise. From the best English Hymn Writers. Selected and arranged by Sir ROUNDELL PALMER. A New and Enlarged Edition.

The Fairy Book; the best Popular Fairy Stories. Selected and rendered anew by the Author of "John Halifax, Gentleman."

"*A delightful selection, in a delightful external form; full of the physical splendour and vast opulence of proper fairy tales.*"—Spectator.

The Ballad Book. A Selection of the Choicest British Ballads. Edited by William ALLINGHAM.

"*His taste as a judge of old poetry will be found, by all acquainted with the various readings of old English ballads, true enough to justify his undertaking so critical a task.*"—Saturday Review.

The Jest Book. The Choicest Anecdotes and Sayings. Selected and arranged by Mark LEMON.

"*The fullest and best jest book that has yet appeared.*"—Saturday Review.

Bacon's Essays and Colours of Good and Evil. With Notes and Glossarial Index. By W. ALDIS WRIGHT, M.A.

The Pilgrim's Progress from this World to that which is to come. By John Bunyan.

"*A beautiful and scholarly print.*"—Spectator.

The Sunday Book of Poetry for the Young. Selected and arranged by C. F. Alexander.

"*A well-selected volume of sacred poetry.*"—Spectator.

A Book of Golden Deeds of all Times and all Countries. Gathered and narrated anew. By the Author of "The Heir of Redclyffe."

The Poetical Works of Robert Burns. Edited, with Biographical Memoir, Notes, and Glossary, by Alexander Smith. Two vols.

The Adventures of Robinson Crusoe. Edited from the Original Edition by J. W. Clark, M.A., Fellow of Trinity College, Cambridge.

The Republic of Plato. Translated into English, with Notes by J. Ll. Davies, M.A., and D. J. VAUGHAN, M.A.

The Song Book. Words and Tunes from the best Poets and Musicians. Selected and arranged by John Hullah, Professor of Vocal Music in King's College, London.

La Lyre Francaise. Selected and arranged, with Notes, by Gustave Masson, French Master in Harrow School.

Tom Brown's School Days. By An Old Boy.

A Book of Worthies. Gathered from the Old Histories and written anew by the Author of "The Heir of Redclyffe."

MACMILLAN & CO., LONDON.

NOTICE OF REMOVAL.

L. OERTLING,

OF 27, MOORGATE STREET,

CHEMICAL BALANCE MANUFACTURER,

WILL REMOVE ON THE 1ST AUGUST TO HIS NEW FACTORY,

TURNMILL STREET,

NEAR FARRINGDON STREET STATION.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR JULY 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF JULY NUMBER—Our Illustrations:—1. "Thomas Carlyle," by J. D. Crittenden. 2. "Mother and Child," by W. Cave Thomas. 3. "Queen Elizabeth appointing her Successor," by R. Smirke, R.A.—The Exhibitions.—The Decoration of St. Paul's.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

CLARENDON PRESS PUBLICATIONS.

Now ready, in 4to, cloth, price 3*l.* 7*s.*

An ICELANDIC-ENGLISH DICTIONARY, Based on the M.S. Collections of the late RICHARD CLEASBY. Enlarged and completed by GUDBRAND VIGFUSSON, M.A. With an Introduction and Life of CLEASBY by G. WEBBE DASENT, D.C.L. (Part III., completing the work, 25*s.*)

"The greatest help to English Philology that has yet been published."—*Times.*

The LOGIC of HEGEL. Translated from the Encyclopædia of the Philosophical Sciences. By W. WALLACE, Fellow and Tutor of Merton College. With Prolegomena. 8vo, 14*s.*

The THIRD BOOK of ST. IRENÆUS, BISHOP of LYONS, against HERESIES. With Short Notes and Glossary by H. DEANE, B.D. Crown 8vo, 5*s.* 6*d.*

NEW VOLUMES OF THE CLARENDON PRESS SERIES.

"Such Manuals, so admirable in matter, arrangement, and type, were never before given to the world at the same moderate price."—*Spectator.*

The WORKS of HORACE. Edited with Introductions, Essays, and English Notes. By E. C. WICKHAM, M.A., Head Master of Wellington College. Vol. I. Odes and Epodes. 8vo, 12*s.*

COWPER'S The TASK. With Tirocinium and Selections from the Minor Works. Edited, with Life and Notes, by H. T. GRIFFITH, M.A. Extra fcap. 8vo, 3*s.*

SELECT TITLES, from the DIGEST of JUSTINIAN. Edited by T. E. Holland, B.C.L. and C. L. SHADWELL, B.C.L. Part I. Introductory Titles. 8vo, 2*s.* 6*d.*

A CONSTITUTIONAL HISTORY of ENGLAND. Its Origin and Development. By W. STUBBS, M.A., Regius Professor of Modern History at Oxford. Vol. I. Crown 8vo, 12*s.*

GENEALOGICAL TABLES, Illustrative of MODERN HISTORY. By Hereford B. GEORGE, M.A. F.R.G.S. 4to, 12*s.*

Oxford: Printed at the "Clarendon Press," and Published by MACMILLAN & CO., London, Publishers to the University.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, July 16, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 247, Vol. 10] THURSDAY, JULY 23, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved

PROFESSORSHIP IN BIOLOGY.

DURHAM UNIVERSITY COLLEGES of

MEDICINE and PHYSICAL SCIENCE, Newcastle-upon-Tyne —It is proposed to establish a Chair of Biology combined with Physiology, in connection with the above Institutions, in October next. Salary £450, with a portion of fees Candidates for the office are invited to apply (with testimonials) to Theo Wood Bunning, Secretary to the College of Physical Science, Newcastle, before the 15th August next, from whom full particulars as to duties, &c , may be obtained.

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY,

1841–1872, is now ready, including both Authors Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5s , by post 5s 4d ; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY

now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1s.

TWO SCHOLARSHIPS and an EXHIBITION

in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A. B. SHEPHERD, M.B.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus, F.R.S. ; Dr. Frankland, F R S., Dr. Roscoe, F R S , Dr. Angus Smith, F.R S , Dr. Tyndall, F.R.S. ; Dr. Voelcker, F R S , Dr. Williamson, F R S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate Analyses and investigations conducted —Apply to Prof E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W

TO NATURALISTS and GEOLOGISTS.

—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS (See Advertisement in NATURE of June 18th) For particulars of these Collections address Fredc. Collingwood, Esq , F.G S , 4, St Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."

July 8th.

MATHEMATICS and PHYSICS.—Mr. F.

HUME TALBOT, M A , late Junior Student of Christ Church, Oxford, First-Class in Mathematics and Natural Science, receives a few PUPILS, in a country home, and prepares them for the Army and Military Colleges, the Universities and the Scientific Professions For further particulars apply to Mr F. H. Talbot, Speen, Newbury, Berks.

SCIENCE TUITION by CORRESPONDENCE.

—Subjects : Botany, Elementary Chemistry, and Practical Use of the Microscope Pupils will have the use of a large Scientific Library, Apparatus, &c —For Terms, address H , care of Macmillan & Co , 29, Bedford Street, Strand, London, W C

The REV. L. HENSLEY, Vicar of Hitchin,

Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities

---

NATURE.—Wanted clean Copies of Nos.

10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W C.

To ASTRONOMERS and OTHERS.—A

skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D W., Doctor's Cottages, South Shore, Blackpool

---

NORFOLK AND NORWICH NATURALISTS' SOCIETY.

The TRANSACTIONS for 1873–74, containing, with other original Papers, a List of the FISHES of Norfolk, with Introduction and Remarks by Dr. JNO LOWE. Price 2s. to non-members.

Also a Supplement containing a List of the LEPIDOPTERA of Norfolk, with Remarks on the rarer Species, by CHAS G. BARRETT. Pp 80. Price 2s. to non-members.

Sent post-free by the Assistant-Secretary, Mr. Jno Quinton, Jun , Literary Institution, St. Andrews, Norwich, on receipt of postage stamps.

EDUCATION AT ZURICH.—Mr. DE BAUDISS, formerly one of the Assistant Masters at Wellington College, receives a limited number of PUPILS, and will have vacancies in October. The house is healthily situated, and the style of living is arranged to suit English habits. Mr. de Baudiss is assisted by competent Masters, and is able to offer, in addition to French and German and the usual subjects of a liberal education, special facilities for the study of Physical and Mechanical Science. Advanced Pupils have the opportunity of attending the Lectures of the Polytechnic School, on Engineering, Agriculture, and other branches of Applied Science.—For terms and references apply to F. de Baudiss, Wiesenstrasse, Seefeld, Zurich.

A GENTLEMAN who contemplates going to South Africa, sheep-farming, wishes to meet with a Companion with some knowledge of Natural Science and Veterinary Surgery, who would join him on mutual terms to be agreed upon.—Address "Farmer," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

A LARGE FARMER in one of the Southern Counties of England has a VACANCY for an Articled Pupil. Could live with the family.—Apply by letter to Mr. William Rutherford, care of the Editor of NATURE, Bedford Street, Strand, W.C.

The HEAD-MASTER of a Grammar School, who is a Graduate of Cambridge, wishes to take two or three Pupils with him on a Continental Tour during the month of August.—For terms and further particulars apply to Head-Master, care of NATURE, 29, Bedford Street, Covent Garden, London.

BEES, Four Hives of, for Sale, in Glass-backed Observatory Hives, 20s. and 25s. each.—A.B., 17, Bellamy Street, Balham.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 „ ... ... One Guinea.

Collections and Specimens of British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.

Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
„ Double „ 31s. 6d., 42s., and 52s. 6d.
„ Umbilical „ 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

In 18mo, cloth, price 1s 6d.

INTRODUCTION TO IRISH FARMING.

BY

THOMAS BALDWIN, M.R.I.A.,

Superintendent of the Agricultural Department of National Education in Ireland, and Author of various Treatises on Agriculture.

CONTENTS:—

CHAPTER I.

MANURES

1. How Land becomes Exhausted
2. Farmyard Manure
3. Liquid Manure
4. Artifical Manures
5. Lime

CHAPTER II.

THE CROPS TO GROW, AND HOW TO GROW THEM

1. The Potato
2. Carrots and Parsnips
3. Turnips and Mangold Wurtzel
4. Cabbage and Rape
5. Grain Crops
6. Beans and Peas
7. Forage and Herbage Crops
8. Clovers
9. The Grasses
10. Haymaking
11. On Flax

CHAPTER III.

LIVE STOCK

1. On the Food of Animals
2. The several kinds of Cattle suited to Irish Farmers

CHAPTER III (*Continued*)

3. On the Rearing of Calves
4. The Feeding of Milch Cows
5. On Dairy Management
6. On the Fattening of Cattle
7. The Farm Horse
8. On Sheep
9. On Swine
10. On Poultry

CHAPTER IV.

EXAMPLES OF SUCCESSFUL FARMING

1. A Farm of Five and a half Acres
2. One-horse Farms
3. Two-horse Farms
4. A Farm of 140 Acres of Good Deep Land
5. A few General Considerations on the Climate and other Matters affecting Irish Agriculture
6. Examples on a Large Scale of the Foregoing Argument
7. A Farm of 2,200 Acres in County Mayo
8. On the Reclamation and Management of a Large Tract of Land

CHAPTER V.

COTTAGE GARDENING

A few SELECTIONS from NOTICES of the First Edition of Professor BALDWIN'S WORK on

IRISH AGRICULTURE.

"The information it gives is sound and good. The book proves the author is well qualified to fill the important office which he holds."—JOHN CHALMERS MORTON, Esq., Editor of *Cyclopædia of Agriculture, &c.*

"Pregnant with useful information for farmers of this country. If the rising generation be instructed and well grounded in what it sets forth, we have no fear for the result."—*Irish Farmer's Gazette.*

"It is one of the best and most useful books published by the Board, combining science with practice. It is just the work which suits the classes for which it is intended. It is written with remarkable perspicuity."—*Freeman's Journal.*

"To landlords, agents, and farmers, large and small, we most heartily recommend Mr. Baldwin's book."—*Irish Farmer and Sportsman.*

"This work is just what the small farmer requires."—*The Newry Examiner.*

"We would wish to notice at greater length this really valuable little manual, which cannot be too highly praised, or too strongly recommended to the study of our friends, the small farmers of Ireland. We heartily congratulate Mr. Baldwin on the success he has achieved, and welcome his little work as a most valuable contribution to agricultural literature."—*Nation.*

"This is one of the most useful little volumes which we have ever had before us, and one which no student of agriculture should be without."—*Leinster Express.*

"No farmer should be without a copy of this treatise, which is plainly written, and pregnant with information."—*Irish Times.*

"It ought to be in the possession of every farmer."—*Cork Examiner.*

"We would wish to see thousands of copies purchased by those who have the means, and distributed amongst those small farmers to whom it may otherwise be as a sealed book."—*Dublin Evening Post.*

"This treatise is sound, and comes very seasonably, when the Irish farmer has every inducement to improve his practice."—*The Field*

"Mr. Baldwin's books are thoroughly trustworthy. His subjects are treated in a masterly manner. May be heartily recommended as well-packed store-rooms of agricultural facts."—*Gardeners' Chronicle and Agricultural Gazette.*

"We strongly recommend Mr. Baldwin's books to the farmers. We admire their lucidity and arrangement."—*Waterford Mail.*

London: MACMILLAN & CO.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d.; or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE.

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations.
Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING

and Flesh-forming Qualities of nearly all the Feeding Substances in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle.—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and meat stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST.

A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading.

Price 6d. per month, or 5s. per annum, Post Free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7s. 6d. each

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED FROM AN ACRE OF SOIL

by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

HOLLOWAY'S PILLS.—In general debility, mental depression, and nervous irritability, there is no medicine which operates so like a charm as these Pills. They purify the blood, soothe and strengthen the nerves and system, give tone to the stomach, elevate the spirits, and, in fact, make the patient sensible of a total and most delightful revolution in his whole system. They may be commended most unreservedly as the very best family medicine in existence. Though so powerfully efficacious, they are singularly mild in their operation, and might be given with perfect confidence to delicate women and young children. They contain not a grain of mercury or any other noxious substance, and cannot do harm. Delicate females and all persons of sedentary habits will find these Pills a blessing.

MR. MURRAY'S

FOREIGN HANDBOOKS.

HANDBOOK of TRAVEL TALK. 3s. 6d.
„ HOLLAND, BELGIUM, and the RHINE to MAYENCE. 6s.
„ NORTH GERMANY, and the RHINE to SWITZERLAND.
„ SWITZERLAND and the ALPS. 9s.
„ SOUTH GERMANY and the TYROL. 10s.
„ FRANCE and the PYRENEES. 12s.
„ PARIS and its ENVIRONS. 3s. 6d.
„ PLAN of PARIS. 3s 6d
„ CORSICA and SARDINIA. 4s.
„ ALGERIA. 6s.
„ NORTH ITALY and VENICE. 10s.
„ CENTRAL ITALY and FLORENCE. 10s.
„ ROME and its ENVIRONS. 10s.
„ SOUTH ITALY and NAPLES. 10s.
„ PORTUGAL and LISBON. 9s.
„ SPAIN and ANDALUSIA. 2 vols. 24s
„ RUSSIA and FINLAND. 15s.
„ NORWAY. 6s.
„ SYRIA and PALESTINE. 2 vols. 24s.
„ MAP of PALESTINE. 12s.
„ BOMBAY and MADRAS. 2 vols. 12s. each.
„ EGYPT and the NILE. 15s.
„ TURKEY and CONSTANTINOPLE. 15s.
„ GREECE and IONIAN ISLANDS. 15s.

JOHN MURRAY, Albemarle Street.

MR. MURRAY'S

ENGLISH HANDBOOKS.

HANDBOOK for LONDON. 3s. 6d.
„ ESSEX, CAMBRIDGE, SUFFOLK, and NORFOLK. 12s.
„ KENT and SUSSEX. 10s.
„ SURREY, HANTS, and ISLE of WIGHT. 10s.
„ BERKS, BUCKS, and OXON. 7s. 6d.
„ WILTS, DORSET, and SOMERSET. 10s.
„ DEVON and CORNWALL. 12s.
„ GLOUCESTER, HEREFORD, and WORCESTER. 9s.
„ SOUTH WALES. 7s.
„ NORTH WALES. 7s.
„ DERBY, STAFFORD, LEICESTER, and NOTTS. 9s.
„ SHROPSHIRE, CHESHIRE, and LANCASHIRE 10s.
„ YORKSHIRE. 12s.
„ DURHAM and NORTHUMBERLAND. 9s.
„ WESTMORELAND and CUMBERLAND 6s.
„ MAP of the LAKE DISTRICT. 3s. 6d.

HANDBOOK—SCOTLAND. 9s.

HANDBOOK—IRELAND. 12s.

JOHN MURRAY, Albemarle Street.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B, F.L.S , British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s. 6d. bound in cloth); also covers for the volume (price 1s.), and back numbers.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible].)

"The Brewers' Guardian" is published on the Evenings of every alternat Tuesday, and is the only journal officially connected with brewing interests Subscription, 16s. 6d. per annum, post free, dating from any quarter-day Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E C.

Just published, with 8 Illustrations, 8vo, cloth, price 21s.

The BIRDS of SHETLAND, with Observations on their Habits, Migration, and Occasional Appearance. By the late HENRY L SAXBY, M.D. Edited by his Brother, Rev. STEPHEN H. SAXBY, of East Clevedon.

Edinburgh: MACLACHLAN & STEWART.
London: SIMPKIN, MARSHALL, & CO.

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

8vo, sewed, 1s.

COMETS and the NEW COMET of 1874.
With a complete popular Account of all that is known of these wonderful bodies which are so great a perplexity to science.

London: WILLIAM TEGG & CO., Pancras Lane, Cheapside.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 8, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

THE EXTENSION

OF THE

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

COMMITTEE.

Professor RAMSAY, LL.D. F.R.S., Director-General of Geological Survey.
Sir PHILLIP DE GRAY MALPAS EGERTON, Bart., M.P. F.R.S. F.G.S.
Sir JOHN LUBBOCK, Bart., M.P. F.R.S. F.L.S. F.G.S.
Sir JOHN HAWKSHAW, C.E., 33, Great George Street, Westminster.
JOHN EVANS, Esq., F.R.S. F.G.S., President of Geological Society.
R. GODWIN-AUSTEN, F.R.S., President of Section C, British Association, 1872.
JOSEPH PRESTWICH, Esq., F.R.S., Ex-President of the Geological Society of London.
WARINGTON SMYTH, Esq., F.R.S., Chief Inspector of Crown Mines.
H. W. BRISTOW, Esq., F.R.S., Director of Geological Survey.
THOMAS HAWKSLEY, Esq., Ex-President of the Institute of Civil Engineers.
W. BOYD DAWKINS, Esq., M.A. F.R.S. F.G.S., Owens College, Manchester.
W. TOPLEY, Esq., F.G.S., Geological Survey of England.
Professor RUPERT JONES, F.G.S., Royal Military College, Sandhurst.
H. WOODWARD, Esq., F.R.S., British Museum.
S. OWENS, Esq., Whitefriars, Fleet Street.
ROBERT ETHERIDGE, Esq., Jermyn Street Museum, Hon. Sec. (*pro. tem.*)
HENRY WILLETT, Esq., F.G.S., Arnold House, Brighton.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

These latter, consisting of the Silurian, Devonian, and Carboniferous series, rise to the surface in Belgium, where the coal is largely worked; they pass under the chalk in the north of France, and reappear in Somersetshire and South Wales. They therefore range under the south-east of England at a depth now sought to be ascertained, and there is reason to believe that they lie at a depth not exceeding 1,500 to 2,000 ft. at Battle.

This determination, therefore, of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal-measures of Belgium and Somerset.

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft. reached, but as yet without any positive result. The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay, and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance.

HENRY WILLETT, Esq., of Arnold House, Brighton, who has so energetically superintended the work, has kindly consented, at the special request of the Committee, to receive Subscriptions, and to continue to act as Treasurer and Honorary Secretary.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH,

TISLEY'S

PENDULUM APPARATUS,

	£	s.	d.
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

	£	s.	d.
For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5	5	0

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

THE LINGUIST,

AND

EDUCATIONAL REVIEW.

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE ZOOLOGIST.

A MONTHLY JOURNAL OF NATURAL HISTORY.

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

WORKS BY I. TODHUNTER, M.A., F.R.S.

"Perspicuous language, vigorous investigations, scrutiny of difficulties, and methodical treatment, characterise Mr. Todhunter's works."—*Civil Engineer.*

ALGEBRA. For the Use of Colleges and Schools. Sixth Edition. Crown 8vo, cloth. 7*s*. 6*d*.

This work contains all the propositions which are usually included in elementary treatises on Algebra, and a large number of Examples for Exercise. The author has sought to render the work easily intelligible to students, without impairing the accuracy of the demonstrations, or contracting the limits of the subject. The Examples, about sixteen hundred and fifty in number, have been selected with a view to illustrate every part of the subject. The work will be found peculiarly adapted to the wants of students who are without the aid of a teacher. The Answers to the Examples, with hints for the solution of some in which assistance may be needed, are given at the end of the book. In the present edition two New Chapters and Three Hundred miscellaneous Examples have been added.

KEY to ALGEBRA for the USE of COLLEGES and SCHOOLS. Crown 8vo., 10s. 6d.

An ELEMENTARY TREATISE on the THEORY of EQUATIONS. Second Edition, revised. Crown 8vo, cloth, 7*s*. 6*d*.

This treatise contains all the propositions which are usually included in elementary treatises on the theory of Equations, together with Examples for exercise. These have been selected from the College and University Examination Papers, and the results have been given when it appeared necessary. In order to exhibit a comprehensive view of the subject, the treatise includes investigations which are not found in all the preceding elementary treatises, and also some investigations which are not to be found in any of them. For the second edition the work has been revised and some additions have been made, the most important being an account of the Researches of Prof. Sylvester respecting Newton's Rule.

PLANE TRIGONOMETRY. For Schools and Colleges. Fourth Edition. Crown 8vo, cloth, 5*s*.

The design of this work has been to render the subject intelligible to beginners, and at the same time to afford the student the opportunity of obtaining all the information which he will require on this branch of Mathematics. Each chapter is followed by a set of Examples; those which are entitled Miscellaneous Examples, together with a few in some of the other sets, may be advantageously reserved by the student for exercise after he has made some progress in the subject. In the Second Edition the hints for the solution of the Examples have been considerably increased.

A TREATISE on SPHERICAL TRIGONOMETRY. Third Edition, enlarged. Crown 8vo, cloth, 4*s*. 6*d*.

The present work is constructed on the same plan as the treatise on Plane Trigonometry, to which it is intended as a sequel In the account of Napier's Rules of circular parts, an explanation has been given of a method of proof devised by Napier, which seems to have been overlooked by most modern writers on the subject. Considerable labour has been bestowed on the text in order to render it comprehensive and accurate, and the Examples (selected chiefly from College Examination Papers) have all been carefully verified.

PLANE CO-ORDINATE GEOMETRY, as applied to the Straight Line and the Conic Sections. With numerous Examples. Fourth Edition, revised and enlarged. Crown 8vo, cloth, 7*s*. 6*d*.

The author has here endeavoured to exhibit the subject in a simple manner for the benefit of beginners, and at the same time to include in one volume all that students usually require. In addition, therefore, to the propositions which have always appeared in such treatises, he has introduced the methods of abridged notation, which are of more recent origin; these methods, which are of a less elementary character than the rest of the work, are placed in separate chapters, and may be omitted by the student at first.

A TREATISE on the DIFFERENTIAL CALCULUS. With numerous Examples. Sixth Edition. Crown 8vo, cloth, 10*s*. 6*d*.

The author has endeavoured in the present work to exhibit a comprehensive view of the Differential Calculus on the method of limits. In the more elementary portions he has entered into considerable detail in the explanations, with the hope that a reader who is without the assistance of a tutor may be enabled to acquire a competent acquaintance with the subject. The method adopted is that of Differential Coefficients. To the different chapters are appended Examples sufficiently numerous to render another book unnecessary; these Examples being mostly selected from College Examination Papers. This and the following work have been translated into Italian by Prof. Battaglini.

A TREATISE on the INTEGRAL CALCULUS and its APPLICATIONS. With numerous Examples. Fourth Edition, revised and enlarged. Crown 8vo, cloth, 10*s*. 6*d*.

This is designed as a work at once elementary and complete, adapted for the use of beginners, and sufficient for the wants of advanced students. In the selection of the propositions, and in the mode of establishing them, it has been sought to exhibit the principles clearly, and to illustrate all their most important results. The process of summation has been repeatedly brought forward, with the view of securing the attention of the student to the notions which form the true foundation of the Calculus itself, as well as of its most valuable applications. Every attempt has been made to explain those difficulties which usually perplex beginners, especially with reference to the *limits* of integrations. A new method has been adopted in regard to the transformation of multiple integrals. The last chapter deals with the Calculus of Variations. A large collection of Exercises, selected from College Examination Papers, has been appended to the several chapters.

EXAMPLES of ANALYTICAL GEOMETRY of THREE DIMENSIONS. Third Edition, revised. Crown 8vo, cloth, 4*s*.

MACMILLAN & CO., LONDON.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

In royal 8vo, cloth extra gilt, price 31s. 6d.

CONTRIBUTIONS to SOLAR PHYSICS.

By J. NORMAN LOCKYER, F.R.S. I. A Popular Account of Inquiries into the Physical Constitution of the Sun, with especial reference to Recent Spectroscopic Researches. II. Communications to the Royal Society of London and the French Academy of Sciences, with Notes. Illustrated by 7 Coloured Lithographic Plates and 175 Woodcuts

"The first part of the work, presenting the reader with a continuous sketch of the history of the various inquiries into the physical constitution of the sun, cannot fail to be of interest to all who care for the revelations of modern science, and the interest will be enhanced by the excellence of the numerous illustrations by which it is accompanied"—*Athenæum.*

"The book may be taken as an authentic exposition of the present state of science in connexion with the important subject of spectroscopic analysis. . . . Even the unscientific public may derive much information from it."—*Daily News.*

London: MACMILLAN & CO.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

NEW VOLUMES OF THE CLARENDON PRESS SERIES.

"Such Manuals, so admirable in matter, arrangement, and type, were never before given to the world at the same moderate price."—*Spectator.*

The WORKS of HORACE. Edited with Introductions, Essays, and English Notes. By E. C. WICKHAM, M.A., Head Master of Wellington College. Vol. I. Odes and Epodes. 8vo, 12s.

COWPER'S The TASK. With Tirocinium and Selections from the Minor Works. Edited, with Life and Notes, by H. T. GRIFFITH, M.A. Extra fcap. 8vo, 3s.

SELECT TITLES, from the DIGEST of JUSTINIAN. Edited by T. E. Holland, B.C.L. and C. L. SHADWELL, B.C.L. Part I. Introductory Titles. 8vo, 2s. 6d.

A CONSTITUTIONAL HISTORY of ENGLAND. Its Origin and Development. By W. STUBBS, M.A., Regius Professor of Modern History at Oxford. Vol. I. Crown 8vo, 12s.

GENEALOGICAL TABLES, Illustrative of MODERN HISTORY. By Hereford B. GEORGE, M.A. F.R.G.S. 4to, 12s.

Oxford: Printed at the "Clarendon Press," and Published by MACMILLAN & CO., London, Publishers to the University.

E. DENT & CO., 61, Strand, & 34, Royal Exchange.
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

NOTICE OF REMOVAL.
L. OERTLING,
OF 27, *MOORGATE STREET,*
CHEMICAL BALANCE MANUFACTURER,
WILL REMOVE ON THE 1ST AUGUST TO HIS NEW FACTORY,
TURNMILL STREET,
NEAR FARRINGDON STREET STATION.

Now ready, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34s.
ELEMENTS OF METALLURGY.
A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.
By J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.
Ancien Elève de l'Ecole des Mines, Paris
"The value of the work is almost inestimable."—*Mining Journal.*
London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

IN THE PRESS.
A NEW WORK BY SIR SAMUEL BAKER.
ISMAILÏA
A NARRATIVE OF
THE EXPEDITION TO CENTRAL AFRICA
FOR THE SUPPRESSION OF
THE SLAVE TRADE.
ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.
By SIR SAMUEL BAKER, PASHA, M.A., F.R.S., F.G.S.,
Major-General of the Ottoman Empire, late Governor-General of Equatorial Nile Basin, Gold Medallist of the Royal Geographical Society, Grande Medaille d'Or de la Société de Géographie de Paris, Honorary Member of the Geographical Societies of Paris and Berlin, Author of the "Albert N'yanza Great Basin of the Nile," the "Nile Tributaries of Abyssinia," "Eight Years' Wanderings in Ceylon," "The Rifle and Hound in Ceylon," &c.
MACMILLAN & CO., LONDON.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.
PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr Hassall, September 23, 1863; Dr. Lankester, September 10, 1867; Dr Letheby, February 15, 1865, and December 1872.
House Cistern, fitted with a Cistern Filter.
Portable Cistern Filter.
Price £1 10s and upwards. Portable Filters on this system, £1 5s to £3.
Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham, by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s. 6d. and 21s. each.
Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.
Pocket Filters from 4s. 6d to 6s each. Household and Fancy Filters from 12s 6d.
The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.
Read "Water: its Impurities and Purification," price, per post, 2d.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, July 23, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 248, Vol. 10] THURSDAY, JULY 30, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

BRITISH ASSOCIATION for the ADVANCEMENT OF SCIENCE,

22, Albemarle Street, London, W.

The NEXT ANNUAL GENERAL MEETING will be held at BELFAST, commencing on WEDNESDAY, August 19

President-Elect,

Professor TYNDALL, D.C.L. LL.D. F.R.S. F.C.S.

NOTICE TO CONTRIBUTORS OF MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section. . . . . . ." If it should be inconvenient to the Author that his paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,
Assistant General Secretary, Harrow.

GEOLOGICAL MINERALOGY.—SIX

ELEMENTARY LECTURES on ROCKS and METALLIC MINERALS, adapted to a Juvenile Audience, will be given by Professor TENNANT, at his residence, 149, Strand, W.C., on AUGUST, 3, 4, 5, 6, 7, and 8, at 10 a.m. and 3 p.m. Terms—Half a Guinea for the Course.

Professor TENNANT will probably afterwards repeat the Elementary Lectures on Mineralogy and Geology given during last Easter and Christmas Holidays

PROFESSORSHIP IN BIOLOGY.

DURHAM UNIVERSITY COLLEGES of

MEDICINE and PHYSICAL SCIENCE, Newcastle-upon-Tyne.—It is proposed to establish a Chair of Biology combined with Physiology, in connection with the above Institutions, in October next. Salary £450, with a portion of fees. Candidates for the office are invited to apply (with testimonials) to Theo. Wood Bunning, Secretary to the College of Physical Science, Newcastle, before the 15th August next, from whom full particulars as to duties, &c., may be obtained

TWO SCHOLARSHIPS and an EXHI-

BITION in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St. Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A. B. SHEPHERD, M.B.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F.R.S.; Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

BIRKBECK LITERARY and SCIENTI-

FIC INSTITUTION, Southampton Buildings, Chancery Lane.—Evening Classes are held in the following Scientific Subjects:—Theoretical Mechanics, Chemistry, Experimental Physics, Mathematics, Geology, Mineralogy, Botany, Physiology, Biology, Microscopy, Physical Geography, Applied Mechanics, Steam, Practical Geometry, and Machine and Building Construction. Classes are also formed for Languages, Literature, History, Law, Logic, Political Economy, Drawing, Shorthand, &c. Library of 7,000 volumes. Quarterly Subscription, 6s. Prospectus gratis on application.

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

The determination of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal-measures of Belgium and Somerset.

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft. reached, but as yet without any positive result. The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay; and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance.

Subscriptions may be sent to Henry Willett, Esq., Hon. Sec. and Treasurer, Arnold House, Brighton.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W

MATHEMATICS and PHYSICS.—Mr. F. HUME TALBOT, M.A., late Junior Student of Christ Church, Oxford, First-Class in Mathematics and Natural Science, receives a few PUPILS, in a country home, and prepares them for the Army and Military Colleges, the Universities and the Scientific Professions For further particulars apply to Mr. F. H. Talbot, Speen, Newbury, Berks.

SCIENCE TUITION by CORRESPONDENCE.—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope Pupils will have the use of a large Scientific Library, Apparatus, &c.—For Terms, address H., care of Macmillan & Co., 29, Bedford Street, Strand, London, W.C.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

A GENTLEMAN who contemplates going to South Africa, sheep-farming, wishes to meet with a Companion with some knowledge of Natural Science and Veterinary Surgery, who would join him on mutual terms to be agreed upon.—Address "Farmer," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

A LARGE FARMER in one of the Southern Counties of England has a VACANCY for an Articled Pupil Could live with the family.—Apply by letter to Mr. William Rutherford, care of the Editor of NATURE, Bedford Street, Strand, W.C.

The HEAD-MASTER of a Grammar School, who is a Graduate of Cambridge, wishes to take two or three Pupils with him on a Continental Tour during the month of August.—For terms and further particulars apply to Head-Master, care of NATURE, 29, Bedford Street, Covent Garden, London.

BEES, Four Hives of, for Sale, in Glass-backed Observatory Hives, 20s. and 25s. each.—A.B., 17, Bellamy Street, Balham.

TO NATURALISTS and GEOLOGISTS.—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS. (See Advertisement in NATURE of June 18th.) For particulars of these Collections address Fredc. Collingwood, Esq., F.G.S., 4, St. Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."

July 8th.

FOR SALE.

AN AMATEUR'S COLLECTION of FOSSILS (stratigraphically arranged) Precious Stones, Agates, Sea, Land, and Freshwater Shells. Suitable for a student of Primeval and Progressive Natural History. For particulars apply to X.Y.Z., care of the Publisher of NATURE, 29, Bedford Street, Strand, W.C.

TELESCOPE FOR SALE.—A Six-inch EQUATORIAL by Messrs. Cooke and Sons.—For full particulars, apply to Capt. E. Barnes, Bridlington-Quay.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s., Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

NORFOLK AND NORWICH NATURALISTS' SOCIETY.

The TRANSACTIONS for 1873–74, containing, with other original Papers, a List of the FISHES of Norfolk, with Introduction and Remarks by Dr. JNO. LOWE. Price 2s. to non-members.

Also a Supplement containing a List of the LEPIDOPTERA of Norfolk, with Remarks on the rarer Species, by CHAS G. BARRETT. Pp. 80. Price 2s. to non-members.

Sent post-free by the Assistant-Secretary, Mr Jno Quinton, jun., Literary Institution, St. Andrews, Norwich, on receipt of postage stamps.

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY, 1841–1872, is now ready, including both Authors Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5s., by post 5s. 4d.; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1s.

HOLLOWAY'S PILLS.—Palpitation of the heart is frequently not only felt but heard; prevents sleep, and begets the utmost dread of impending suffocation. These Pills are particularly recommended for removing this affection, because they strengthen the nervous and the debilitated, who are much more liable to this malady than other persons. Holloway's Pills so improve the digestion, increase the action of the liver, and give activity to the bowels, that giddiness, headache, and nausea depart as the palpitation diminishes, and the sufferer at once experiences the most indescribable relief from anxiety. Holloway's Pills form the best alterative and aperient in all cases of convalescence from fevers, inflammations, neuralgia, and all chronic diseases which have impoverished the blood and brain.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

THE QUARTERLY REVIEW, No. 273,
IS JUST PUBLISHED.

CONTENTS.

I. The Isle of Wight.
II. Primitive Man—Tylor and Lubbock.
III. The Countess of Nithsdale.
IV. English Vers de Société.
V. Motley's John of Barneveld—Diplomacy in the 16th Century.
VI. The Labour Movement at Home and Abroad.
VII. Japan as it was and is.
VIII. Victor Amadeus: a Reversal of History.
IX. The State of the Church.

JOHN MURRAY, Albemarle Street.

THE BRITISH QUARTERLY REVIEW

For July, No. CXIX., is now ready, price 6s., containing:—

1. The Depths of the Sea.
2. David Friedrich Strauss.
3. Lord Ellenborough's Indian Administration.
4. Science, Philosophy, and Religion.
5. The Primæval Archæology of Rome.
6. Far Russia.
7. The Tory Administration.
8. Finger Rings.
9. Contemporary Literature.

London: HODDER & STOUGHTON, 27 and 31, Paternoster Row.

The JOURNAL of the ANTHROPOLOGICAL INSTITUTE of GREAT BRITAIN and IRELAND, No. 9, January 1874, Illustrated, price 6s. contains:—Papers on Anthropological Statistics from Schools, Ancient Burial Ground of Peru; Anthropology at Bradford, the Siah Posh Kafirs; Hieroglyphics of Easter Island; Exploration of Caves Ha and Pontnewydd, a Human Fibula from Victoria Cave, Translation of the Han Annals; Westerly Drifting of the Huns; the Nagas; Monuments of the Khasi Hills; Description of a Samoiedo Skull; Skulls from the Peat of Ely.—The Annual General Meeting and Presidential Address of Prof. Busk, with Discussion and Anthropological Miscellanea.

TRÜBNER & CO., Ludgate Hill, London.

MACMILLAN'S MAGAZINE.

No. 178. FOR AUGUST.
PRICE 1s.

CONTENTS—

1.—"Victor Hugo's Dramas." By Camille Barrère.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XVII.—XVIII.
3.—"Addresses at Cheshunt College." By the Dean of Westminster.
4.—"The Convent of San Marco." II. The Frate.
5.—"Church Reform: Local Government."
6.—"On the Perception of the Invisible." By G. F. Rodwell.
7.—"Foundling Hospitals in Italy." By Lady Amberley.
8.—"The Grouping of Plants." By H. Evershed.
9.—"Pictura Poesis."
10.—"The Civil Service of India." By W. B. Scoones.

MACMILLAN & CO., London.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL
AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

SCIENTIFIC WORKS.

The Principles of Science. By Prof. JEVONS, F.R.S. A Treatise on Logic and Scientific Method. Two vols 8vo, 25s.

Elements of Physical Manipulation. By EDWARD C. PICKERING, Professor of Physics in the Massachusetts Institute of Technology. Part I. 8vo, 10s. 6d.

The Beginnings of Life: being some Account of the Nature, Modes of Origin, and Transformation of Lower Organisms. By H. CHARLTON BASTIAN, M.D. F.R.S. With upwards of 100 Illustrations. 2 vols crown 8vo, 28s.

First Principles of Chemical Philosophy. By J. P. COOKE, JUN., Erving Professor of Chemistry and Mineralogy in Harvard College. Crown 8vo, 12s. Third Edition, revised and corrected.

Acadian Geology. The Geologic Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island. By J. W. DAWSON, LL.D. F.R.S., Principal of McGill College and University, Montreal. Second Edition, revised and enlarged. With Geological Map and Illustrations, 8vo, 18s.

Hereditary Genius: an Inquiry into its Laws and Consequences. By FRANCIS GALTON, F.R.S. 8vo. 12s.

The Theory of Evolution of Living Things, and the Principles of Evolution applied to Religion, considered as Illustrative of the Wisdom and Beneficence of the Almighty. By the Rev. GEORGE HENSLOW, M.A. F.R.S. Crown 8vo, 6s.

The Student's Flora of the British Islands. By J. D. HOOKER, C.B. F.R.S., President of the Royal Society. Globe 8vo, 10s. 6d.

*Professor Huxley's Lay Sermons, Ad*dresses, and Reviews. New and cheaper Edition, 7s. 6d.

*Professor Huxley's Critiques and Ad*dresses 8vo, 10s. 6d.

On the Genesis of Species. By St. George MIVART, F.R.S. Second Edition, with Notes in reference and reply to Darwin's "Descent of Man." With numerous Illustrations. Crown 8vo, 9s.

Habit and Intelligence, in Connection with the Laws of Matter and Force. By J. J. MURPHY. 2 vols. 8vo, 16s.

The Scientific Bases of Faith. By J. J. MURPHY. 8vo, 14s.

Sound and Music: a Non-mathematical Treatise on the Physical Constitution of Musical Sounds and Harmony, including the chief Acoustical Discoveries of Professor Helmholtz. By SEDLEY TAYLOR, M.A. Crown 8vo, 8s. 6d.

Contributions to the Theory of Natural SELECTION. A Series of Essays. By ALFRED RUSSELL WALLACE. Second Edition, with Corrections and Additions. Crown 8vo, 8s. 6d.

MACMILLAN & CO., LONDON.

Now ready, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34*s*.

ELEMENTS OF METALLURGY.

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.

Ancien Elève de l'Ecole des Mines, Paris

"The value of the work is almost inestimable."—*Mining Journal.*

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

Will be published shortly.

NEW VOLUME OF "*NATURE* SERIES."

THE TRANSIT OF VENUS.

BY GEORGE FORBES, B.A.,

PROFESSOR OF NATURAL PHILOSOPHY IN THE ANDERSONIAN UNIVERSITY, GLASGOW.

With numerous Illustrations. Crown 8vo.

Now ready.

A New and thoroughly Revised Edition of

J. & A. CHURCHILL'S CATALOGUE OF

560 MEDICAL and SCIENTIFIC WORKS.

This Edition possesses the following New Features.—

1. The Enlargement of the Catalogue to 84 pages
2. The Insertion of several Works which, for want of space, had been omitted from recent Editions.
3. The number of Pages contained in each Work.
4. The Date of Publication of each Work
5. A full Index to Titles and Subjects to facilitate Reference.

*** A Copy will be sent on receipt of one stamp for postage.

11, New Burlington Street.

The BIRDS of SHETLAND, with Observations on their Habits, Migration, and Occasional Appearance. By the late HENRY L. SAXBY, M.D. Edited by his Brother, Rev. STEPHEN H. SAXBY, of East Clevedon.

Edinburgh: MACLACHLAN & STEWART.

London: SIMPKIN, MARSHALL, & CO.

Just published, in 1 vol. royal 8vo, Revised Edition of

JERDON'S MAMMALS OF INDIA: a Natural History of all the Animals known to inhabit Continental India. Price 21*s*.

J. WHELDON, 58, Great Queen Street, London.

"*NATURE*."

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s*. 6*d*.

Cloth Cases for binding all the volumes, price 1*s*. 6*d*. each.

Reading Cases to hold 26 numbers, price 2*s*. 6*d*.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER, OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

THOMAS D. RUSSELL, GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 "	One Guinea.

Collections and Specimens of

British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

THE JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York, 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U S A.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S, Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c, and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 10*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, S W.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R ELLIS & SON, RUTHIN," and every Label bears their Trade Mark Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales

LONDON AGENTS.—W BEST & SONS, Henrietta Street, Cavendish Square.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments

Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals
Monocular, £5; Binocular, £10 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from $\frac{1}{4}$ to $\frac{1}{25}$ inch, unequalled for their brilliant Defining and Penetrating Power

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14*s.*; 4½ in., 17*s*; 6 in., in Wooden Case, 10*s*, including a Kew Certificate

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.— JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES. — Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c, by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c —Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 10 other shades.

JUDSON'S DYES.—For Staining Wood.— Diluted with Water They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut, Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

NEW BOOKS.

This day, in 8vo, price 21s.

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the Orders of Her Majesty's Government, with Incidental Notices of the Countries traversed by the Lines. By Colonel Sir FREDERIC GOLDSMID, C.B. K.C.S.I., late Director of the Government Indo-European Telegraph. With numerous Illustrations and Maps.

DEDICATED BY SPECIAL PERMISSION TO THE QUEEN.

MENDELSSOHN. By Ferdinand Hiller. Letters and Recollections. Translated by M. E. VON GLEHN. With Lithographic Portrait from a Drawing by Carl Muller, never before published. Crown 8vo, 7s. 6d. [This day.

TECHNICAL TRAINING. By Thomas TWINING (one of the Vice-Presidents of the Society of Arts). Being a Suggestive Sketch of a National System of Industrial Instruction, founded on a general diffusion of Practical Science among the People. 8vo, 12s. [This day.

BIRDS: their Cages and their Keep. Being a Practical Manual of Bird-keeping and Bird-rearing. By K. A. BUIST. With Coloured Frontispiece and other Illustrations. Crown 8vo, 5s. [This day.

DISESTABLISHMENT AND DISENDOWMENT, WHAT ARE THEY? By EDWARD A. FREEMAN, D.C.L. Crown 8vo, 2s. 6d. [This day.

PRIMER of PHYSIOLOGY. By Dr. MICHAEL FOSTER, F.R.S. With numerous Illustrations, 18mo, cloth, 1s. (Macmillan's "Science Primers.") [This day.

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices, by B. H. KENNEDY, D.D., Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6s. [This day.

ESSAYS and ADDRESSES, by PROFESSORS and LECTURERS of Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. 8vo, 14s. [This day.

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor MASSON. Crown 8vo, 5s. [This day.

A GRAMMAR of the LATIN LANGUAGE. Part II. By H. J. ROBY, M.A., late Fellow of St. John's College, Cambridge. Crown 8vo. [Immediately.

MODERN UTILITARIANISM; or, the Systems of Paley, Bentham, and Mill examined and compared. By T. R. BIRKS, M.A., Professor of Moral Philosophy at Cambridge. Crown 8vo. [Just ready.

New Edition, corrected and improved, extra fcap. 8vo, 6s.

FIRST FORMS of VEGETATION. By the Rev. HUGH MACMILLAN, LL.D. F.R.S.E., Author of "Bible Teachings in Nature," &c. With Coloured Frontispiece and other Illustrations.

MACMILLAN & CO., LONDON.

SCIENTIFIC CLASS BOOKS.

POPULAR ASTRONOMY. By Sir G. B. AIRY, K.C.B., Astronomer Royal. Seventh Edition, 18mo, with Illustrations, 4s. 6d.

"Popular Astronomy in general has many manuals, but none of them supersede the Six Lectures of the Astronomer Royal under that title. Its speciality is the direct way in which every step is referred to the observatory, and in which the methods and instruments by which every observation is made are fully described. This gives a sense of solidity and substance to astronomical statements which is obtainable in no other way."—*Guardian.*

ELEMENTARY LESSONS in ASTRONOMY. By J. NORMAN LOCKYER, F.R.S. With Coloured Diagram of the Spectra of the Sun, Stars, and Nebulæ. New Edition, 18mo, with Illustrations, 5s. 6d.

"The book is full, clear, and sound."—*Athenæum.*

QUESTIONS on the SAME. 1s. 6d.

LESSONS in ELEMENTARY BOTANY. By Professor OLIVER, F.R.S. F.L.S. New Edition, 18mo, with Illustrations, price 4s. 6d.

"We know of no work so well suited to direct the botanical pupil's efforts as that of Professor Oliver."—*Natural History Review.*

LESSONS in ELEMENTARY CHEMISTRY. By Professor ROSCOE. New Edition, 18mo, with numerous Illustrations and Chromo-lithographs of the Solar Spectra, 4s. 6d.

"A small, compact, carefully elaborated, and well-arranged manual."—*Spectator.*

ELEMENTARY LESSONS in LOGIC, Deductive and Inductive. By Professor JEVONS. With copious Questions and Examples, and a Vocabulary of Logical Terms. New Edition, 18mo, 3s. 6d.

"Nothing can be better for a school-book."—*Guardian.*

LESSONS in ELEMENTARY PHYSIOLOGY. By Professor HUXLEY. New Edition, 18mo, with numerous Illustrations, price 4s. 6d.

QUESTIONS on the SAME. 1s. 6d.

POLITICAL ECONOMY for BEGINNERS. By MILLICENT GARRETT FAWCETT. With Questions. New Edition, 18mo, 2s. 6d.

"Clear, compact, and comprehensive."—*Daily News.*

LESSONS in ELEMENTARY PHYSICS. By BALFOUR STEWART, F.R.S., Professor of Natural Philosophy in Owens College, Manchester. New Edition, 18mo, with Coloured Diagram and numerous Illustrations, 4s. 6d.

LESSONS IN ELEMENTARY ANATOMY. By ST. GEORGE MIVART, F.R.S. &c., Lecturer on Comparative Anatomy at St. Mary's Hospital, Author of "The Genesis of Species." With upwards of 400 Illustrations.

These Lessons are intended for teachers and students of both sexes not already acquainted with anatomy. The author has endeavoured, by certain additions and by the mode of treatment, also to fit them for students in medicine, and generally for those acquainted with human anatomy, but desirous of learning its more significant relations to the structure of other animals.

"It may be questioned whether any other work on anatomy contains in like compass so proportionately great a mass of information."—*Lancet.*

"The work is excellent, and should be in the hands of every student of human anatomy."—*Medical Times.*

AN ELEMENTARY TREATISE ON STEAM. By JOHN PERRY, B.E., Whitworth Scholar, F.C.S., late Lecturer on Physics at Clifton College. 4s. 6d.

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light. The numerous examples and exercises will prove useful in all Physics classes; whether the whole course is followed or not; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's H

IN PREPARATION.

ELEMENTARY LESSONS in PHYSICAL GEOGRAPHY. By ARCHIBALD GEIKIE, F.R.S., Professor of Geology at Edinburgh. With numerous Illustrations.

ELEMENTARY LESSONS in GEOLOGY. By Professor GEIKIE.

MACMILLAN & CO., LONDON.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s, 26s. 6d., and 31s. 6d.
,, Double ,, 31s. 6d, 42s., and 52s. 6d.
,, Umbilical ,, 42s and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

BRYANT & MAY'S
MATCHES.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY.

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M B, F.L.S., British Museum, assisted by J G BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s post free in the United Kingdom) payable advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W C., of whom may be obtained the volume for 1873 (price 16s 6d. bound in cloth) · also covers for the volume (price 1s.), and back numbers

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co, Stationers' Hall Court.

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

CLARENDON PRESS PUBLICATIONS.

A TREATISE ON ELECTRICITY AND MAGNETISM. By J CLERK MAXWELL, M.A. F.R.S., Professor of Experimental Physics in the University of Cambridge. 2 vols. 8vo, £1 11s 6d.

The GEOLOGY of the VALLEY of the THAMES. By JOHN PHILLIPS, M.A. F R S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo, 21s.

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum*

VESUVIUS. By John Phillips, M.A., F.R.S. With numerous Maps and Illustrations. Crown 8vo, 10s. 6d.

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction His plan has been successfully carried out, and has resulted in a work of high value"—*Pall Mall Gazette.*

DESCRIPTIVE ASTRONOMY. A Handbook for the General Reader, and also for practical Observatory work. With 224 Illustrations and numerous Tables By G F. CHAMBERS, F.R.A.S, Barrister-at-Law. Demy 8vo, cloth, 856 pp, price 21s.

CHEMISTRY FOR STUDENTS. By A. W. WILLIAMSON, Phil. Doc. F.R.S., Professor of Chemistry, University College, London. New Edition, with Solutions. Extra fcap. 8vo, cloth, price 8s. 6d.

EXERCISES IN PRACTICAL CHEMISTRY. By A G VERNON HARCOURT, M.A. F.R.S., Senior Student of Christ Church, and Lee's Reader in Chemistry; and H. G. MADAN, M A., Fellow of Queen's College, Oxford. Series I., Qualitative Exercises. Second Edition. Crown 8vo, price 7s 6d.

AN ELEMENTARY TREATISE ON HEAT. By BALFOUR STEWART, LL.D F R.S., Professor of Natural History in Owens College, Manchester. Ext. fcap 8vo, with numerous Woodcuts and Diagrams, 7s. 6d. New Edition, revised and enlarged.

"The publication of this manual is exceedingly well-timed; it includes within narrow limits the leading facts and principles of this younger-born of the Sciences, and for the mastery of the greater portion of the contents only requires ordinary intelligence on the part of the reader."—*Spectator.*

FORMS OF ANIMAL LIFE. Being Outlines of Zoological Classification based upon Anatomical Investigation, and illustrated by Descriptions and Specimens and of Figures. By G. ROLLESTON, M.D. F.R S., Linacre Professor of Physiology, Oxford. Demy 8vo, price 16s.

A TREATISE on ACOUSTICS. By W. J DONKIN, F R S, Savilian Professor of Astronomy in the University of Oxford Crown 8vo, price 7s 6d

A SYSTEM OF PHYSICAL EDUCATION: Theoretical and Practical With 346 Illustrations drawn by A. MACDONALD, of the Oxford School of Art. By ARCHIBALD MACLAREN, The Gymnasium, Oxford. Ext. fcap. 8vo, price 7s. 6d.

"The work before us is one which should be in the hands of every schoolmaster and schoolmistress. It is marked in every line by good sense, and is so clearly written that no one can mistake its rules"—*Lancet.*

ELEMENTS OF NATURAL PHILOSOPHY. By Sir W. THOMSON, LL D. D.C.L. F.R.S., Professor of Natural Philosophy, Glasgow. and P. G. TAIT, M.A, Professor of Natural Philosophy, Edinburgh. Part I, 8vo, 9s.

Oxford: Printed at the Clarendon Press, and Published by MACMILLAN & CO., London, Publishers to the University.

VICHY WATERS COMPANY,

27, MARGARET STREET, REGENT STREET, LONDON, W.

DEPOT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

NOTICE OF REMOVAL.

L. OERTLING,

OF 27, MOORGATE STREET,

CHEMICAL BALANCE MANUFACTURER,

WILL REMOVE ON THE 1ST AUGUST TO HIS NEW FACTORY,

TURNMILL STREET,

NEAR FARRINGDON STREET STATION.

NOW READY.

PRICE 1s.

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER OF PHYSIOLOGY.

BY

MICHAEL FOSTER, M.A., M.D., F.R.S.,

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

With Illustrations.

MACMILLAN & CO., LONDON.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR JULY 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSA, ITAQUE HOMINIS."

CONTENTS OF JULY NUMBER—Our Illustrations:—1. "Thomas Carlyle," by J. D. Crittenden. 2. "Mother and Child," by W. Cave Thomas. 3. "Queen Elizabeth appointing her Successor," by R. Smirke, R.A.—The Exhibitions.—The Decoration of St. Paul's.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, July 30, 1874.

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

NO. 249. VOL. 10] THURSDAY, AUGUST 6, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office

[All Rights are Reserved.

OWENS COLLEGE (MANCHESTER ROYAL) SCHOOL of MEDICINE.

Principal—J. G GREENWOOD, LL.D

Director of Medical Studies—GEORGE SOUTHAM, F.R.C.S.

PROFESSORS AND LECTURERS.

General Anatomy and Physiology ...	William Smith, F.R C S
Practical Physiology and Histology ...	Arthur Gamgee, M D F R S.
Descriptive and Practical Anatomy ...	The Professor of Anatomy J Beswick Perrin, M R.C S. F.L S
Comparative Anatomy and Botany ...	W C. Williamson, F R S.
Chemistry	Henry E. Roscoe, B A Ph.D. F R S
Medicine	William Roberts, M D. B A F R C P. John E. Morgan, M.D. M.A F R C P
Surgery	George Southam, F.R C S Edward Lund, F.R C S.
Ophthalmic Surgery	Thomas Windsor, M R C S
Pathology and Morbid Anatomy	Henry Simpson, M D. M.R C S. Julius Dreschfeld, M D
Midwifery and Diseases of Women and Children	John Thorburn, M D. L.R.C S
Materia Medica and Therapeutics .	Alexander Somers M R C.S. Daniel John Leech, M B
Forensic Medicine	G Morley Harrison, M R C S.
Hygiene and Public Health	Arthur Ransome, M.D. M.A. M.R.C.S.
Clinical Medicine	The Physicians to the Royal Infirmary
Clinical Surgery	The Surgeons to the Royal Infirmary
Medical Tutor	J. Beswick Perrin, M R.C S. F L S

The Winter Season will commence on the 1st October The new Medical School Buildings will be opened on the 2nd October by Professor T H Huxley, F R.S. A composition fee of £50, payable in two instalments, with an annual tutorial fee of £2 2s, admits to the complete course of study at the School, and a further sum of £42 to the Hospital Practice at the Royal Infirmary.

Prospectuses will be forwarded on application.

J HOLME NICHOLSON, Registrar.

OWENS COLLEGE, MANCHESTER.

The next SESSION will commence on the 6th of OCTOBER.

Prospectuses of the several Departments of the Day Classes, Evening Classes, and Medical School, and also of Scholarships and Entrance Exhibitions, will be forwarded on application.

J HOLME NICHOLSON, Registrar.

A LARGE FARMER in one of the Southern Counties of England has a VACANCY for an Articled Pupil Could live with the family.—Apply by letter to Mr William Rutherford, care of the Editor of NATURE, Bedford Street, Strand, W.C.

TWO SCHOLARSHIPS and an EXHIBITION in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A. B. SHEPHERD, M B.

MIDDLESEX HOSPITAL.

ENTRANCE SCHOLARSHIPS.

Two Scholarships, of the annual value of £25 and £20 respectively, will be competed for on September 28th and following days These Scholarships are open to all gentlemen who commence their medical studies in October 1874 Successful candidates will be required to become general students of the College.

For full particulars as to subjects of examination, &c, apply to the Dean.

ROBERT KING, B A. M B, Dean

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

SCHOLARSHIPS IN SCIENCE

Two Scholarships in Science have been founded at St Bartholomew's Hospital :—

1. An Open Scholarship of the value of £100, tenable for one year, to be competed for in September. The subjects of examination are Physics, Chemistry, Botany, and Zoology The successful candidate will be required to enter at St. Bartholomew's Hospital in October next.

2 Preliminary Scientific Scholarship of the value of £50, tenable for one year, to be competed for in October next by Students of the Hospital of less than six months' standing. The subjects of examination are identical with those of the Open Scholarship.

For further particulars and syllabus of subjects, application may be made personally or by letter to the Warden of the College, St Bartholomew's Hospital.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

The WINTER SESSION will begin on THURSDAY, October 1

The Clinical Practice of the Hospital comprises a service of 710 Beds, inclusive of 34 Beds for Convalescents at Highgate

Students can reside within the Hospital walls, subject to the College regulations.

For all particulars concerning either the Hospital or College, application may be made, personally or by letter, to the Resident Warden of the College

A Handbook will be forwarded on application.

The HEAD-MASTER of a Grammar School, who is a Graduate of Cambridge, wishes to take two or three Pupils with him on a Continental Tour during the month of August.—For terms and further particulars apply to Head-Master, care of NATURE, 29, Bedford Street, Covent Garden, London.

ROYAL MEDICAL COLLEGE AT EPSOM.

A TEACHER of BIOLOGY is required to attend twice a week in term time. He must be able to prepare a Class for the First B Sc. of London. Stipend, £80 a year.

Apply to the Rev. Dr. West, Head-Master, at the Vicarage, Ryde, Isle of Wight

---

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education or Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus. F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F.R.S.; Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

MATHEMATICS and PHYSICS.—Mr. F. HUME TALBOT, M.A., late Junior Student of Christ Church, Oxford, First-Class in Mathematics and Natural Science, receives a few PUPILS, in a country home, and prepares them for the Army and Military Colleges, the Universities and the Scientific Professions. For further particulars apply to Mr. F. H. Talbot, Speen, Newbury, Berks.

SCIENCE TUITION by CORRESPONDENCE.—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope. Pupils will have the use of a large Scientific Library, Apparatus, &c.—For Terms, address H., care of Macmillan & Co., 29, Bedford Street, Strand, London, W.C.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

The determination of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal-measures of Belgium and Somerset.

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft reached, but as yet without any positive result. The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay, and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance.

Subscriptions may be sent to Henry Willett, Esq., Hon. Sec. and Treasurer, Arnold House, Brighton.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH.

A GENTLEMAN who contemplates going to South Africa, sheep-farming, wishes to meet with a Companion with some knowledge of Natural Science and Veterinary Surgery, who would join him on mutual terms to be agreed upon.—Address "Farmer," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

BEES, Four Hives of, for Sale, in Glass-backed Observatory Hives, 20s. and 25s. each.—A.B., 17, Bellamy Street, Balham.

TO NATURALISTS and GEOLOGISTS.—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS. (See Advertisement in NATURE of June 18th.) For particulars of these Collections address Fredc. Collingwood, Esq., F.G.S., 4, St. Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."

July 8th.

CRAG FOSSILS from the Coralline and Red Crags. 50 species, 15s., 100 species, 30s.; 200 species, 70s. Complete Lists of Crag Fossils, 9d. MINERALS and ROCKS: 150 examples, £2 2s.; 250 ditto, £4; or with half fossils, £3 10s. 6d.—A. BELL, 5, Grafton Street, Fitzroy Square, London, W.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 „ ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

The SECOND MASTER of a High-class Grammar School receives a few Resident Pupils. Special attention is given to the study of Natural Sciences.—For further particulars apply by letter to "Tripos," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

WANTED.—SKELETONS of a few of the SMALLER BRITISH BIRDS, to complete a Collection.—Address particulars to F.Z.S., care of Editor of NATURE, Bedford Street, Strand, W.C.

NOTICE.—To Science Classes.—MOT-TERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHE-MICAL SOCIETY, 1841–1872, is now ready, including both Authors Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5s., by post 5s. 4d.; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SO-CIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr. Van Voorst by a subscription of £1 1s.

The JOURNAL of the ANTHROPOLOGICAL INSTITUTE of GREAT BRITAIN and IRELAND, No 9, January 1874, Illustrated, price 6s. contains :—Papers on Anthropological Statistics from Schools, Ancient Burial Ground of Peru ; Anthropology at Bradford ; the Siah Posh Kafirs, Hieroglyphics of Easter Island ; Exploration of Caves Ha and Pontnewydd , a Human Fibula from Victoria Cave ; Translation of the Han Annals ; Westerly Drifting of the Huns , the Nagas ; Monuments of the Khasi Hills , Description of a Samoiede Skull ; Skulls from the Peat of Ely.—The Annual General Meeting and Presidential Address of Prof. Busk, with Discussion and Anthropological Miscellanea.

TRÜBNER & CO., Ludgate Hill, London.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE BREWERS' GUARDIAN :

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES ; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternat Tuesday, and is the only journal officially connected with brewing interests Subscription, 16s. 6d. per annum, post free, dating from any quarter-day Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S , Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c , and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free) 4½d.

37, Southampton Street, Covent Garden, S.W.

MACMILLAN'S MAGAZINE.

No. 178. FOR AUGUST.

PRICE 1s.

CONTENTS—

1.—"Victor Hugo's Dramas." By Camille Barrère.
2.—"Castle Daly : The Story of an Irish Home Thirty Years Ago." Chapters XVII.—XVIII.
3.—"Addresses at Cheshunt College." By the Dean of Westminster.
4.—"The Convent of San Marco." II. The Frate.
5.—"Church Reform : Local Government."
6.—"On the Perception of the Invisible" By G. F Rodwell.
7.—"Foundling Hospitals in Italy." By Lady Amberley.
8.—"The Grouping of Plants." By H. Evershed.
9.—"Pictura Poesis."
10.—"The Civil Service of India." By W. B. Scoones.

MACMILLAN & CO., London.

THE LINGUIST,

AND

EDUCATIONAL REVIEW :

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries ; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London : Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C. ; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE ZOOLOGIST :

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists ;" those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London : JOHN VAN VOORST, 1, Paternoster Row.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations, Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each ; the succeeding vols. may be had separately or together at 7s. each.

London : JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

NEWMAN'S ENTOMOLOGIST :

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects ; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co , Stationers' Hall Court.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B, F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s. 6d. bound in cloth) · also covers for the volume (price 1s), and back numbers.

Now ready, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34s.

ELEMENTS OF METALLURGY.

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.C.S., F.G.S., &c.

Ancien Elève de l'Ecole des Mines, Paris.

"The value of the work is almost inestimable."—*Mining Journal.*

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and FLESH-FORMING QUALITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading. Price 6*d.* per month, or 5*s.* per annum, post-free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

Preparing for Publication (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOIL, by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

The BIRDS of SHETLAND, with Observations on their Habits, Migration, and Occasional Appearance. By the late HENRY L. SAXBY, M.D. Edited by his Brother, the Rev. Stephen H. Saxby, of East Clevedon.

Edinburgh: MACLACHLAN & STEWART.
London: SIMPKIN, MARSHALL, & CO.

Just published, free for one stamp.

THE NATURAL HISTORY and SCIENTIFIC BOOK CIRCULAR, No. 9, JULY, containing Valuable Works on Botany, Chemistry, Conchology, Entomology, General Natural History, Geology, Meteorology, Ornithology, &c.—Wm. Wesley, 28, Essex Street, Strand, London.

ZOOLOGICAL SOCIETY'S LATEST PUBLICATIONS.

"Proceedings of the Scientific Meetings of the Society for 1874."—Part II., containing the Papers read at the Scientific Meetings in March and April 1874. With 17 Plates, mostly coloured, 12*s.*; with Plates, uncoloured, 3*s.*

Index to the Proceedings of the Zoological Society from 1830 to 1847, from 1848 to 1860, and from 1861 to 1870, in three volumes. Price 6*s.* each volume.

NOTICE.

Commencing from January of the present year the "Proceedings" will be issued in four Parts, as follows:—

Part I., containing Papers read in January and February, on June 1st.
" II., " " March and April, on August 1st.
" III., " " May and June, on October 1st.
" IV., " " November and December, on April 1st.

The price will be 12*s.* per Part for the Edition with coloured, and 3*s.* per Part for that with uncoloured Plates.

These may be obtained at the Society's Office, 11, Hanover Square, W.; at Messrs. Longmans, Paternoster Row, E.C., or through any bookseller.

COMPLETION of Mr. SPEDDING'S LIFE of LORD BACON.—The Seventh Volume of the Letters and Life of FRANCIS BACON, including all his Occasional Works, collected and edited by J. Spedding, M.A. Hon Fell Trin. Coll. Camb., with a copious Index, completing the work, is now ready, price 12*s.*

London: LONGMANS & CO.

The CIRCLE and STRAIGHT LINE. By (KUKLOS) JOHN HARRIS.

Part 1, 8vo, pp 42, with Plates, cloth	4*s.*
" 2, 8vo, pp 56 " "	4*s.*
" 3, 8vo, pp. 26 " "	4*s.*
Supplement, 8vo, pp. 28 " "	4*s.*
The above, complete	12*s.* 6*d.*

London: TRÜBNER & CO., 57 and 59, Ludgate Hill.

Just published, 4to, price 24*s.*

OSTEOLOGIA AVIUM; or, a Sketch of the Osteology of Birds. By T. C. EYTON, Esq., F.G.S. F.L.S.

SUPPLEMENT II., Part II., 20 Plates, 4to, 24*s.*

By the same Author.

OSTEOLOGIA AVIUM; or, a Sketch of the Osteology of Birds. By T. C. EYTON, Esq. 250 pp. Text and 116 Plates, 2 vols. 4to, cloth, £7.

SUPPLEMENT I., 18 Plates, 4to, cloth, 10*s.*

SUPPLEMENT II., Part I, 20 Plates, 4to, 24*s.*

A SYNOPSIS of the ANATIDÆ, or DUCK TRIBE. By T. C EYTON, Esq. Crown 8vo, 5*s.*

LIST of PLATES of SKELETONS of BIRDS that have been published. 6*d.*

WILLIAMS & NORGATE, 14, Henrietta Street, Covent Garden, London, and 20, South Frederick Street, Edinburgh.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	*s.*	*d.*
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & CO.

OFFICE, 29 BEDFORD STREET, STRAND, W.C.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,

66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.

Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

TISLEY'S

PENDULUM APPARATUS,

	£	*s.*	*d.*
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the Instrument to work on	12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen	0	3	0
A Set of 30 including the principal Figures from 1 : 1 to 1 : 3	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution — £5 5

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s.*, 21*s.*, 26*s.* 6*d.*, and 31*s.* 6*d.*
" Double " 31*s.* 6*d.*, 42*s.*, and 52*s.* 6*d.*
" Umbilical " 42*s.* and 52*s.* 6*d.*
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s.* 6*d.*, 7*s.* 6*d.*, 10*s.*, and 16*s.* each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

NOW READY.

PRICE 1*s.*

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER OF PHYSIOLOGY.

BY

MICHAEL FOSTER, M.A., M.D., F.R.S.,

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

With Illustrations.

MACMILLAN & CO., LONDON.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR AUGUST 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF AUGUST NUMBER—Our Illustrations:—1. "Henry Fawcett, Esq., M.P., and Mrs. Fawcett,' by Ford Madox-Brown. 2. "The Knight in Armour," by Wm. Cave Thomas. 3. "Lesson in Network," by J. F. Millet.—The Exhibitions: The Royal Academy, the Munich Gallery.—The Decoration of St. Paul's Cathedral, No. 2.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effective. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

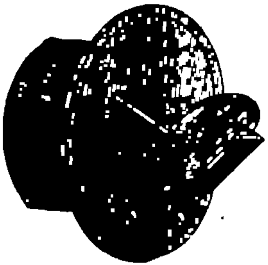
London: MACMILLAN & CO.

FOR MICROSCOPE DRAWING

THE

NEUTRAL TINT CAMERA

Is the easiest and best, and can be fitted to any Microscope Eye-piece by sending Cap for size per post. Price 7s. 6d. Post Orders payable at Great Portland Street.



CHAS. COLLINS,

Maker to the Government,

157, GREAT PORTLAND ST,

LONDON, W.

SOLE MAKER OF THE

"HARLEY"

BINOCULAR MICROSCOPE.

ILLUSTRATED CATALOGUE OF MICROSCOPES and all Apparatus free per post on application.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

HOLLOWAY'S PILLS.—Excellent Pills.—The resources of medicine and chemistry were long and fruitlessly tried before they yielded a remedy which could overcome disorders of the stomach and nerves till Professor Holloway discovered his purifying and tonic Pills. They are the safest and surest correctives of indigestion, heartburn, flatulency, torpidity of the liver, twitchings, nervous fancies, despondency, low spirits, and declining strength. Holloway's Pills supersede all irregular action in the body, and so strengthen and support the system that disease departs and leaves the patient not at all shaken. This is the grand aim and object of medical art, to regulate disordered functions without damaging the constitution by the remedy and admirably is this end attained by Holloway's Pills.

NEW BOOKS.

This day, in 8vo, price 21s.

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the Orders of Her Majesty's Government; with Incidental Notices of the Countries traversed by the Lines By Colonel Sir FREDERIC GOLDSMID, C B. K C S I, late Director of the Government Indo-European Telegraph. With numerous Illustrations and Maps.

DEDICATED BY SPECIAL PERMISSION TO THE QUEEN.

MENDELSSOHN. By Ferdinand Hiller. Letters and Recollections Translated by M E. von Glehn. With Lithographic Portrait from a Drawing by Carl Müller, never before published Crown 8vo, 7s. 6d. [This day.

TECHNICAL TRAINING. By Thomas TWINING (one of the Vice-Presidents of the Society of Arts) Being a Suggestive Sketch of a National System of Industrial Instruction, founded on a general diffusion of Practical Science among the People 8vo, 10s. [This day.

BIRDS: their Cages and their Keep. Being a Practical Manual of Bird-keeping and Bird-rearing By K. A BUIST. With Coloured Frontispiece and other Illustrations Crown 8vo, 5s. [This day.

DISESTABLISHMENT AND DISENDOWMENT, WHAT ARE THEY? By EDWARD A FREEMAN, D.C.L. Crown 8vo, 2s. 6d. [This day.

PRIMER of PHYSIOLOGY. By Dr. MICHAEL FOSTER, F R S With numerous Illustrations, 18mo, cloth, 1s. (Macmillan's "Science Primers") [This day.

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices, by B H KENNEDY, D D, Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6s. [This day.

ESSAYS and ADDRESSES, by PROFESSORS and LECTURERS of Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873 8vo, 14s. [This day.

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor MASSON. Crown 8vo, 5s. [This day.

A GRAMMAR of the LATIN LANGUAGE. Part II. By H J. ROBY, M.A., late Fellow of St. John's College, Cambridge. Crown 8vo [Immediately

MODERN UTILITARIANISM; or, the Systems of Paley, Bentham, and Mill examined and compared. By T. R. BIRKS, M.A, Professor of Moral Philosophy at Cambridge Crown 8vo [Just ready.

New Edition, corrected and improved, extra fcap. 8vo, 6s.

FIRST FORMS of VEGETATION. By the Rev. HUGH MACMILLAN, LL D F.R.S.E., Author of "Bible Teachings in Nature," &c With Coloured Frontispiece and other Illustrations.

MACMILLAN & CO., LONDON.

SCIENTIFIC CLASS BOOKS.

POPULAR ASTRONOMY. By Sir G. B. AIRY, K C B., Astronomer Royal. Seventh Edition, 18mo, with Illustrations, 4s 6d.

"Popular Astronomy in general has many manuals, but none of them supersede the Six Lectures of the Astronomer Royal under that title. Its speciality is the direct way in which every step is referred to the observatory, and in which the methods and instruments by which every observation is made are fully described. This gives a sense of solidity and substance to astronomical statements which is obtainable in no other way."—*Guardian.*

ELEMENTARY LESSONS in ASTRONOMY. By J. NORMAN LOCKYER, F R.S. With Coloured Diagram of the Spectra of the Sun, Stars, and Nebulæ. New Edition, 18mo, with Illustrations, 5s. 6d.

"The book is full, clear, and sound."—*Athenæum.*

QUESTIONS on the SAME. 1s. 6d.

LESSONS in ELEMENTARY BOTANY. By Professor OLIVER, F.R S. F L S New Edition, 18mo, with Illustrations, price 4s. 6d

"We know of no work so well suited to direct the botanical pupil's efforts as that of Professor Oliver."—*Natural History Review.*

LESSONS in ELEMENTARY CHEMISTRY. By Professor ROSCOE. New Edition, 18mo, with numerous Illustrations and Chromo-lithographs of the Solar Spectra, 4s. 6d

"A small, compact, carefully elaborated, and well-arranged manual."—*Spectator.*

ELEMENTARY LESSONS in LOGIC, Deductive and Inductive. By Professor JEVONS. With copious Questions and Examples, and a Vocabulary of Logical Terms. New Edition, 18mo, 3s 6d.

"Nothing can be better for a school-book."—*Guardian.*

LESSONS in ELEMENTARY PHYSIOLOGY. By Professor HUXLEY New Edition, 18mo, with numerous Illustrations, price 4s 6d

QUESTIONS on the SAME. 1s. 6d.

POLITICAL ECONOMY for BEGINNERS. By MILLICENT GARRETT FAWCETT. With Questions. New Edition, 18mo, 2s. 6d.

"Clear, compact, and comprehensive"—*Daily News.*

LESSONS in ELEMENTARY PHYSICS. By BALFOUR STEWART, F.R S, Professor of Natural Philosophy in Owens College, Manchester. New Edition, 18mo, with Coloured Diagram and numerous Illustrations, 4s. 6d.

LESSONS IN ELEMENTARY ANATOMY. By ST. GEORGE MIVART, F.R.S. &c., Lecturer on Comparative Anatomy at St. Mary's Hospital, Author of "The Genesis of Species." With upwards of 400 Illustrations.

These Lessons are intended for teachers and students of both sexes not already acquainted with anatomy. The author has endeavoured, by certain additions and by the mode of treatment, also to fit them for students in medicine, and generally for those acquainted with human anatomy, but desirous of learning its more significant relations to the structure of other animals.

"It may be questioned whether any other work on anatomy contains in like compass so proportionately great a mass of information."—*Lancet.*

"The work is excellent, and should be in the hands of every student of human anatomy."—*Medical Times.*

AN ELEMENTARY TREATISE ON STEAM. By JOHN PERRY, B E, Whitworth Scholar, F.C.S., late Lecturer on Physics at Clifton College. 4s. 6d.

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light. The numerous examples and exercises will prove useful in all Physics classes; whether the whole course is followed or not; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's Hill.

IN PREPARATION.

ELEMENTARY LESSONS in PHYSICAL GEOGRAPHY. By ARCHIBALD GEIKIE, F.R S, Professor of Geology at Edinburgh. With numerous Illustrations.

ELEMENTARY LESSONS in GEOLOGY. By Professor GEIKIE.

MACMILLAN & CO., LONDON.

E. DENT & CO., 61, Strand, & 34, Royal Exchange
(FACTORY, SAVOY ST.), LONDON.

MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c., TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.

MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.

MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.

Catalogues or Estimates on Application.

VICHY WATERS COMPANY,
27, MARGARET STREET, REGENT STREET, LONDON, W.
DEPOT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870 See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863, Dr. Lankester, September 10, 1867; Dr. Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10s and upwards Portable Filters on this system, £1 5s. to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s. each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.
Read "Water: its Impurities and Purification," price, per post, 2d.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV From 10s. each. SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, &c.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

1871.—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873—INTERNATIONAL EXHIBITION PRIZE MEDAL.

FLETCHER'S
NEW LOW TEMPERATURE BURNER (PATENT)

This Burner gives a range of heating power from a gentle current of WARM air to a BRIGHT RED HEAT, and is so perfectly under control that a common glass bottle may be placed on the tripod without protection and heated to any required temperature without the slightest risk of fracture. In practical use it dispenses with the necessity for drying-closets, sand-and-water baths, &c.

For very low temperatures the ring must be lighted through the opening B, this causes a current of warm air to rise through the gauze above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube.

Price, without blast tube ... ... 7s. 6d.
" with blast tube for high temperatures ... 9s. 0d.

UNIVERSAL FURNACE (GAS),

For High Temperatures (without blast) for Crucibles, Muffles, &c., in several sizes and patterns. Special designs made to order.

NEW BUNSEN BURNERS, giving a range of temperature up to a clear white heat, 10s. 6d.

HOT BLAST BLOWPIPES, giving temperatures exceeding the fusing-point of platinum, 11s 6d, 13s., 15s.

POWERFUL FOOT-BLOWERS, 18s.

Drawings and description from dealers in Chemical Apparatus, or from

THOMAS FLETCHER, F.C.S.,
13 & 15, SUEZ STREET,
WARRINGTON.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, August 6, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 250, Vol. 10] THURSDAY, AUGUST 13, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office. [All Rights are Reserved.

NOTICE.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

"NATURE"

FOR AUGUST 20

And the following Numbers will contain FULL REPORTS of

THE PRESIDENT'S ADDRESS,

And of the ADDRESSES and PROCEEDINGS in the different Sections.

With the Number for AUGUST 20 will be given a

PORTRAIT,

ENGRAVED ON STEEL BY CH. H. JEENS, OF

PROFESSOR TYNDALL,

With a NOTICE by PROFESSOR HELMHOLZ, forming the FOURTH of the SERIES of Illustrated Articles on

"SCIENTIFIC WORTHIES."

NOTICE TO ADVERTISERS.

Advertisements intended for the above Number should be sent to the Publishers as soon as possible.

Office: 29, BEDFORD STREET, STRAND, W.C.

PHILOSOPHICAL TRANSACTIONS.

The FELLOWS of the ROYAL SOCIETY are hereby informed that the First Part of the "Philosophical Transactions," Vol 164, for the year 1874, is now published, and ready for delivery on application at the Office of the Society in Burlington House, daily, between the hours of 10 and 4

WALTER WHITE,
Burlington House. *Assistant Secretary R S.*

BRITISH ASSOCIATION for the ADVANCEMENT OF SCIENCE,

22, Albemarle Street, London, W.

BELFAST, August 19-26.

President-Elect,

Professor TYNDALL, D C.L. F R.S.

The Journal, President's Address, and other Printed Papers issued by the Association during the Annual Meeting, will be forwarded daily to Members and others who will forward 2s 6d to Mr Stewardson, Clerk of the Association, Reception Room, Belfast, on or before August 19

G GRIFFITH, M.A., Assistant General Secretary.

OWENS COLLEGE, MANCHESTER.

The next SESSION will commence on the 6th of OCTOBER.

Prospectuses of the several Departments of the Day Classes, Evening Classes, and Medical School, and also of Scholarships and Entrance Exhibitions, will be forwarded on application

J. HOLME NICHOLSON, Registrar.

WESTMINSTER HOSPITAL MEDICAL SCHOOL.

(OPPOSITE WESTMINSTER ABBEY)

The SESSION 1874-75 will commence on THURSDAY, October 1st, with an INTRODUCTORY LECTURE by Dr Potter The Address will be followed by the Distribution of the Prizes and a Conversazione in the Board Room

The new Physiological Laboratory will be completed by October 1st

The Examinations for the Entrance Scholarships will be held on the 2nd and 3rd of October.

GEORGE COWELL, Dean

THE MIDDLESEX HOSPITAL COLLEGE.

The WINTER SESSION, 1874-5, will open on OCTOBER 1st, with an INTRODUCTORY ADDRESS at 3 o'clock, by Mr Andrew Clark, F R C S.

The Medical College attached to the Hospital provides the most complete means for the education of Students

The College Tutors superintend and assist all general students in their studies, especially those who are preparing for Examinations, without extra fee, and thus the necessity for obtaining private instruction is obviated.

General Fee for the Curriculum required by the Royal Colleges of Physicians and Surgeons, and the Society of Apothecaries, £90, which may be paid by instalments

For full particulars as to Entrance and other Scholarships, Clinical Appointments, Residence of Students, &c, apply to the Dean.

ROBERT KING, B.A. M.B, Dean.

TWO SCHOLARSHIPS and an EXHIBITION in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A. B. SHEPHERD, M.B.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F.R.S.; Dr. Williamson, F.R.S.

The Term commences Tuesday, September 15.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

SCIENCE TUITION by CORRESPONDENCE.—Subjects: Botany, Elementary Chemistry, and Practical Use of the Microscope. Pupils will have the use of a large Scientific Library, Apparatus, &c.—For Terms, address H., care of Macmillan & Co., 29, Bedford Street, Strand, London, W.C.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

A LARGE FARMER in one of the Southern Counties of England has a VACANCY for an Articled Pupil. Could live with the family.—Apply by letter to Mr. William Rutherford, care of the Editor of NATURE, Bedford Street, Strand, W.C.

A GENTLEMAN who contemplates going to South Africa, sheep-farming, wishes to meet with a Companion with some knowledge of Natural Science and Veterinary Surgery, who would join him on mutual terms to be agreed upon.—Address "Farmer," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

BEES, Four Hives of, for Sale, in Glass-backed Observatory Hives, 20s. and 25s. each.—A.B., 17, Bellamy Street, Balham.

The SECOND MASTER of a High-class Grammar School receives a few Resident Pupils. Special attention is given to the study of Natural Sciences.—For further particulars apply by letter to "Tripos," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

WANTED.—SKELETONS of a few of the SMALLER BRITISH BIRDS, to complete a Collection.—Address particulars to F.Z.S., care of Editor of NATURE, Bedford Street, Strand, W.C.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

The determination of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal-measures of Belgium and Somerset.

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft. reached, but as yet without any positive result. The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay; and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance.

Subscriptions may be sent to HENRY WILLETT, Esq., Hon. Sec. and Treasurer, Arnold House, Brighton.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 „ ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

DIARY OF SOCIETIES.

LONDON

TUESDAY, AUGUST 18.

BIRKBECK SCIENTIFIC SOCIETY, at 8.—Opium, its Preparations and Uses: R. G. Madden.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c.*, *at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

HENRY CROUCH'S
NEW CATALOGUE OF
MICROSCOPES, OBJECTIVES, &c.
With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.
HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,
Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,
London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,
Optician and Manufacturer of
ACHROMATIC MICROSCOPES,
and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,
As supplied to the principal Universities and Hospitals
Monocular, £5; Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/25 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14s.; 4½ in., 17s., 6 in., in Wooden Case, 10s., including a Kew Certificate

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO
88, New Bond Street, W., London.

PURE AERATED WATERS.
ELLIS'S
RUTHIN WATERS,
Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS:—W. BEST & SONS, Henrietta Street, Cavendish Square.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
,, Double ,, 31s. 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O. order.—ALEX. ROSS, 248, High Holborn, London, and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

Ready this day, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34s.

ELEMENTS OF METALLURGY:

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.G.S., F.C.S., &c.

Ancien Élève de l'École des Mines, Paris; Author of "Mining and Metallurgy of Gold and Silver," &c.

"Will be eagerly sought for by Students in Science and Art, as well as by practical workers in metals."—*Colliery Guardian.*

"The value of this work is almost inestimable."—*Mining Journal.*

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

NOW READY.

TECHNICAL TRAINING.

BY THOMAS TWINING,

ONE OF THE VICE-PRESIDENTS OF THE SOCIETY OF ARTS.

Being a Suggestive Sketch of a National System of Industrial Instruction founded on a General Diffusion of Practical Science among the People. 8vo. 12s.

MACMILLAN & CO., LONDON.

WORKS BY THE LATE PROFESSOR PHILLIPS, F.R.S.

The GEOLOGY of the VALLEY of the THAMES. By John Phillips, M.A., F.R.S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo. 21s.

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum.*

VESUVIUS. By John Phillips, M.A. F.R.S. With numerous Maps and Illustrations. Crown 8vo. 10s. 6d.

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction. His plan has been successfully carried out, and has resulted in a work of high value."—*Pall Mall Gazette.*

Oxford: Printed at the CLARENDON PRESS, and Published by MACMILLAN & CO., London, Publishers to the University.

Just published, free for one stamp.

THE NATURAL HISTORY and SCIENTIFIC BOOK CIRCULAR, No. 9, JULY, containing Valuable Works on Botany, Chemistry, Conchology, Entomology, General Natural History, Geology, Meteorology, Ornithology, &c.—WM. WESLEY, 28, Essex Street, Strand, London.

The CIRCLE and STRAIGHT LINE. By (KUKLOS) JOHN HARRIS.

Part 1, 8vo, pp 42, with Plates, cloth	... ...	4s.
,, 2, 8vo, pp 56 ,, ,,	... ...	4s.
,, 3, 8vo, pp. 26 ,, ,,	... ...	4s.
Supplement, 8vo, pp. 28 ,, ,,	... ...	4s.
The above, complete	... ...	12s. 6d.

London: TRÜBNER & CO., 57 and 59, Ludgate Hill.

COMPLETION of Mr. SPEDDING'S LIFE of LORD BACON.—The Seventh Volume of the Letters and Life of FRANCIS BACON, including all his Occasional Works, collected and edited by J. SPEDDING, M.A., Hon. Fell. Trin. Coll. Camb., with a copious Index, completing the work, is now ready, price 12s.

London: LONGMANS & CO.

The ALPINE CLUB MAP of SWITZERLAND and Adjacent Countries engraved on the Scale of 4 Miles to the Inch, constructed under the superintendence of the Alpine Club, and edited by R. C. NICHOLS, F.S.A. Ready on Monday next, complete in Four Sheets, in Portfolio, price 42s. or mounted in a Case, price 52s. 6d. Each Sheet may be had separately, price 12s., or mounted in a Case, price 15s.

London: LONGMANS & CO. and E. STANFORD.

Edinburgh: W. & A. K. JOHNSTON.

The BIRDS of SHETLAND, with Observations on their Habits, Migration, and Occasional Appearance. By the late HENRY L. SAXBY, M.D. Edited by his Brother, the Rev. STEPHEN H. SAXBY, of East Clevedon.

Edinburgh: MACLACHLAN & STEWART.

London: SIMPKIN, MARSHALL, & CO.

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY, 1841–1872, is now ready, including both Authors Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5s., by post 5s. 4d.; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr. Van Voorst by a subscription of £1 1s.

AN ELEMENTARY TREATISE ON STEAM. By JOHN PERRY, B.E., Whitworth Scholar, F.C.S., late Lecturer on Physics at Clifton College. 4s. 6d.

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light. The numerous examples and exercises will prove useful in all Physics classes; whether the whole course is followed or not; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's Hill.

MACMILLAN & CO., LONDON.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 o'clock on Wednesdays.

Post-office Orders payable to MACMILLAN & CO.

OFFICE, 29 BEDFORD STREET, STRAND, W.C.

TISLEY'S PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft square), which serves as a Stand for the instrument to work on — — — — — — — — —	£12	0	0
Reflectors for projecting the Figures on the Screen — —	2	12	6
N.B —Specimen Curves, on card, post free — per dozen —	0	3	0
A Set of 90, including the principal Figures from 1 : 1 to 1 : 3 —	0	7	6
Ditto traced on blackened Glass, for the Lantern — per slide —	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution —	£5	5	0

TISLEY AND SPILLER, OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L S, Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening
Trees and Shrubs.
Hardy Flowers.
Town Gardens
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s* for a Quarter, 9*s* 9*d.* for a Half-year, and 10*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free) 4½*d.*

37, Southampton Street, Covent Garden, S.W.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE LINGUIST, AND EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

MACMILLAN'S MAGAZINE.

No. 178. FOR AUGUST.

PRICE 1s.

CONTENTS—

1.—"Victor Hugo's Dramas." By Camille Barrère.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XVII —XVIII.
3.—"Addresses at Cheshunt College." By the Dean of Westminster.
4.—"The Convent of San Marco" II. The Frate
5.—"Church Reform: Local Government."
6.—"On the Perception of the Invisible" By G. F Rodwell.
7.—"Foundling Hospitals in Italy." By Lady Amberley
8.—"The Grouping of Plants." By H. Evershed.
9.—"Pictura Poesis."
10.—"The Civil Service of India." By W. B. Scoones.

MACMILLAN & CO., London.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations, Conducted by J. W. DOUGLAS, R. MCLACHLAN, F L.S., E. C. RYE, and H. T. STAINTON, F.R.S, &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year

Vols I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10*s.* each; the succeeding vols. may be had separately or together at 7*s.* each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co, Stationers' Hall Court.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B, F L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s.* post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co, Drury House, St. Mary-le-Strand, London, W C., of whom may be obtained the volume for 1873 (price 16*s.* 6*d.* bound in cloth); also covers for the volume (price 1*s.*), and back numbers.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR AUGUST 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.
"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF AUGUST NUMBER—Our Illustrations:—1. "Henry Fawcett, Esq., M.P., and Mrs. Fawcett," by Ford Madox-Brown. 2. "The Knight in Armour," by Wm. Cave Thomas. 3. "Lesson in Network," by J. F. Millet.—The Exhibitions: The Royal Academy, the Munich Gallery.—The Decoration of St. Paul's Cathedral, No. 2.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½d., 1s. 1½d., and 2s. 9d. Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2s. 9d. box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

⁂ The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation, and all the symptoms of Impending Consumption.

LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2s. 9d. by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

⁂ Order of any Chemist.

New Edition, corrected and improved, extra fcap. 8vo, 6s.

FIRST FORMS of VEGETATION. By the Rev. HUGH MACMILLAN, LL.D. F.R.S.E., Author of "Bible Teachings in Nature," &c. With Coloured Frontispiece and other Illustrations.

BRYANT & MAY'S
MATCHES.

This day, in 8vo, price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

HOLLOWAY'S PILLS.—Inflammations Controlled.—All persons should be forewarned by the present sudden atmospheric changes, that their maintenance of health depends upon rectifying disorder in, and expelling impurities from the system without unnecessary delay. Cases of internal inflammation in the throat, lungs, liver, and bowels, are perpetually happening during the winter, and loudly call for a certain curative, such as Holloway's Pills; they supersede blood-letting, mercury, antimony, and similarly dangerous treatment. No invalid will be at a loss to treat his complaint on the surest and safest principles, who carefully reads through the printed directions folded round every box of these Pills. No danger can result from using this medicine, which may be accounted "The Antidote for Inflammation."

MESSRS. MACMILLAN & CO.'S PUBLICATIONS.

Owens College Essays.—Essays and Addresses by Professors and Lecturers of the Owens College, Manchester Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. 8vo, 14*s*.

A series of papers bearing on such questions of literature, science, and politics as are of special interest at the present time, and written by men who are fully competent to deal with the various subjects The following are specimens of the papers.—Original Research as a Means of Education, by Prof Roscoe, Solar Physics, by Prof. Balfour Stewart; On some Relations of Culture to Practical Life, by Prof. Greenwood; Some Historical Results of the Science of Language, by Prof. Wilkins; The Judicature Act of 1873 in its Relation to the History of the Judicial System in England, by Prof. Bryce; The Railways and the State, by Prof. Stanley Jevons, The Peace of Europe, by Prof. Ward, &c.

Professor Cairnes.—Some Leading Principles of Political Economy Newly Expounded. By J. E. CAIRNES, M A., Emeritus Professor of Political Economy in University College, London. 8vo, 14*s*. [This day

Contents:—Value—Supply and Demand—Normal Value—Market Value—Derivative Laws of Value—Rate of Wages—Demand for Commodities—Wages and Prices—Trades' Unionism—Doctrine of Comparative Cost—Wages and Foreign Trade, &c.

The Physiology of the Circulation in Plants, in the Lower Animals, and in Man. By J. BELL PETTIGREW, M.D. F R.S. 8vo. With 150 Illustrations. 12*s*. [This day.

Horæ Hellenicæ.—Essays and Discussions on some important points of Greek Philology and Antiquity. By JOHN STUART BLACKIE, F R.S.E, Professor of Greek in the University of Edinburgh. 8vo, 12*s*. [This day.

The Songs and Ballads of Scotland in view of their Influence on the Character of the People By J. CLARK MURRAY, LL D., Professor of Mental and Moral Philosophy in McGill College, Montreal. Crown 8vo, 6*s*. [This day.

Rendu's Theory of the Glaciers of Savoy. Translated by ALFRED WILLS, Q C, late President of the Alpine Club To which are added the Original Memoir and Supplementary Articles, by Professors TAIT and RUSKIN Edited, with Introductory Remarks, by GEORGE FORBES, B A., Professor of Natural Philosophy in the Andersonian University, Glasgow. 8vo, 7*s*. 6*d*. [This day.

The Apostolical Fathers; a Critical Account of their Genuine Writings and of their Doctrines By JAMES DONALDSON, LL.D. Crown 8vo, 7*s* 6*d*. [This day.

Songs of Consolation. By Isa Craig Knox. Extra fcap 8vo, cloth extra, gilt edges, 4*s*. 6*d* [This day.

Scripture Readings for Schools and Families. Vol. III.—The Kings and the Prophets. By CHARLOTTE M. YONGE, Author of "The Heir of Redclyffe." Extra fcap. 8vo, 1*s* 6*d*. With Comments, 3*s*. 6*d*. (Vol I. and II. 1*s*. 6*d*. each; with Comments, 3*s*. 6*d*) [This day.

The Origin and Metamorphoses of Insects. By Sir JOHN LUBBOCK, M P. F R.S. Second Edition. Crown 8vo. With Illustrations, 3*s* 6*d*. ("NATURE SERIES.") [This day.

Plutarch: his Life, his Lives, and his Morals. Five Lectures by R. CHENEVIX TRENCH, D.D, Archbishop of Dublin. Second Edition, Revised and Enlarged. Fcap 8vo, 3*s*. 6*d*. [This day.

Guide to the Unprotected in Every-day Matters relating to Property and Income. By a BANKER'S DAUGHTER. Fourth Edition, Revised. Extra fcap. 8vo, 3*s*. 6*d*. [This day,

MACMILLAN & CO., LONDON.

SCIENTIFIC WORKS.

The Principles of Science. By Prof. JEVONS, F.R S. A Treatise on Logic and Scientific Method. Two vols 8vo, 25*s*.

Elements of Physical Manipulation. By EDWARD C. PICKERING, Professor of Physics in the Massachusetts Institute of Technology. Part I. 8vo, 10*s*. 6*d*.

The Beginnings of Life: being some Account of the Nature, Modes of Origin, and Transformation of Lower Organisms. By H. CHARLTON BASTIAN, M D. F R.S With upwards of 100 Illustrations. 2 vols. crown 8vo, 28*s*.

First Principles of Chemical Philosophy. By J P. COOKE, jun, Erving Professor of Chemistry and Mineralogy in Harvard College Crown 8vo, 12*s*. Third Edition, revised and corrected.

Acadian Geology. The Geologic Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island. By J W. DAWSON, LL.D. F.R S., Principal of McGill College and University, Montreal Second Edition, revised and enlarged. With Geological Map and Illustrations, 8vo, 18*s*.

Hereditary Genius: an Inquiry into its Laws and Consequences. By FRANCIS GALTON, F.R S. 8vo. 12*s*.

The Theory of Evolution of Living Things, and the Principles of Evolution applied to Religion, considered as illustrative of the Wisdom and Beneficence of the Almighty. By the Rev. GEORGE HENSLOW, M.A. F.R.S. Crown 8vo, 6*s*.

The Student's Flora of the British Islands. By J. D. HOOKER, C.B. F.R.S., President of the Royal Society. Globe 8vo, 10*s*. 6*d*.

Professor Huxley's Lay Sermons, Addresses, and Reviews New and cheaper Edition, 7*s*. 6*d*

Professor Huxley's Critiques and Addresses. 8vo, 10*s*. 6*d*.

On the Genesis of Species. By St. George MIVART, F R S Second Edition, with Notes in reference and reply to Darwin's "Descent of Man." With numerous Illustrations. Crown 8vo, 9*s*.

Habit and Intelligence, in Connection with the Laws of Matter and Force. By J J. MURPHY. 2 vols 8vo, 16*s*.

The Scientific Bases of Faith. By J. J. MURPHY. 8vo, 14*s*.

Sound and Music: a Non-mathematical Treatise on the Physical Constitution of Musical Sounds and Harmony, including the chief Acoustical Discoveries of Professor Helmholtz. By SEDLEY TAYLOR, M.A. Crown 8vo, 8*s*. 6*d*.

Contributions to the Theory of Natural SELECTION. A Series of Essays. By ALFRED RUSSELL WALLACE. Second Edition, with Corrections and Additions. Crown 8vo, 8*s*. 6*d*.

MACMILLAN & CO., LONDON.

VICHY WATERS COMPANY,

27, MARGARET STREET, REGENT STREET, LONDON, W.

DEPOT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

NEW VOLUME OF "*NATURE* SERIES."

THE TRANSIT OF VENUS.

BY GEORGE FORBES, B.A.,

PROFESSOR OF NATURAL PHILOSOPHY IN THE ANDERSONIAN UNIVERSITY, GLASGOW.

With numerous Illustrations. Crown 8vo.

MESSRS. MACMILLAN AND CO.'S NEW BOOKS.

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the orders of Her Majesty's Government, with incidental Notices of the Countries through which the Lines pass. By Colonel Sir FREDERIC GOLDSMID, C.B., K.C.S.I., late Director of the Government Indo-European Telegraph. With numerous Illustrations and Maps. 8vo. [*Immediately.*

DEDICATED BY SPECIAL PERMISSION TO THE QUEEN.

MENDELSSOHN. By Ferdinand Hiller. Letters and Recollections. Translated by M. E. von Glehn. Edited by George Grove. With Lithographic Portrait from a Drawing by Carl Muller, never before published. Crown 8vo. [*Nearly ready*

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices. By B. H. KENNEDY, D.D., Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6*s*. [*This day.*

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor Masson. Crown 8vo. [*Immediately.*

THOUGHTS on REVELATION. By John McLeod Campbell, D.D. Second Edition. Crown 8vo, 5*s*. [*This day.*

NOTES on the PARABLES of OUR LORD. By R. Chenevix Trench, D.D., Archbishop of Dublin. Twelfth Edition, revised. 8vo, 12*s*. [*This day.*

FIRST FORMS of VEGETATION. By the Rev. Hugh Macmillan, LL.D. F.R.S.E., Author of "Bible Teachings in Nature," &c. New Edition, revised and enlarged. With numerous Illustrations. Extra fcap. 8vo. [*Shortly.*

BIRDS: their CAGES and their KEEP. By Lady Dickey. With Illustrations. Crown 8vo. [*Shortly.*

PRIMER of PHYSIOLOGY. By Michael Foster, F.R.S. (Macmillan's Science Primers.) [*Shortly.*

HISTORY of GERMANY. By J. Sime, M.A. (Vol. V. of the Historical Course for Schools.) Edited by E. A. Freeman, D.C.L. 18mo, 3*s*. [*This day.*

EUCLIDIAN GEOMETRY. By Francis Cuthbertson, Head Mathematical Master of the City of London School. Extra fcap. 8vo, 4*s*. 6*d*. [*This day.*

MACMILLAN & CO., LONDON.

Printed by R. Clay, Sons, & Taylor, at 7 and 8, Bread Street Hill, in the City of London, and published by Macmillan & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—Thursday, August 13, 1874.

DOUBLE NUMBER—FOURTH EDITION

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 251, Vol. 10] THURSDAY, AUGUST 20, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office. [All Rights are Reserved.

WESTMINSTER HOSPITAL MEDICAL SCHOOL

(OPPOSITE WESTMINSTER ABBEY.)

The SESSION 1874-75 will commence on THURSDAY, October 1st, with an INTRODUCTORY LECTURE by Dr. Potter. The Address will be followed by the Distribution of the Prizes and a Conversazione in the Board Room

The new Physiological Laboratory will be completed by October 1st.

The Examinations for the Entrance Scholarships will be held on the 2nd and 3rd of October.

GEORGE COWELL, Dean

TWO SCHOLARSHIPS and an EXHIBITION in Natural Science, and a SCHOLARSHIP and EXHIBITION in Classics and Mathematics, will be awarded by Open Competition in the First Week of October next, at St. Mary's Hospital Medical School. For particulars apply to the Dean of the School,

A. B. SHEPHERD, M.B.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F.R.S.; Dr. Williamson, F.R.S.

The Term commences TUESDAY, September 15.

C. WILLMORE, Principal.

ANDERSON'S UNIVERSITY, GLASGOW.

The Trustees invite CANDIDATES for the CHAIR of CHEMISTRY vacant by the resignation of Professor Thorpe

Applications to be lodged, on or before the 1st of September, with the Subscriber, who will furnish information regarding the duties and terms of the appointment

J. B. KIDSTON, Secretary.

50, West Regent Street, Glasgow, 14th August, 1874.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. Gardner, F.E.S., F.S.A., 44, Berners Street, W

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

SCHOLARSHIPS IN SCIENCE.

Two Scholarships in Science have been founded at St Bartholomew's Hospital:—

1 An Open Scholarship of the value of £100, tenable for one year, to be competed for in September. The subjects of examination are Physics, Chemistry, Botany, and Zoology. The successful candidate will be required to enter at St. Bartholomew's Hospital in October next.

2. Preliminary Scientific Scholarship of the value of £50, tenable for one year, to be competed for in October next by Students of the Hospital of less than six months' standing. The subjects of examination are identical with those of the Open Scholarship.

For further particulars and syllabus of subjects, application may be made personally or by letter to the Warden of the College, St. Bartholomew's Hospital.

LONDON LIBRARY,

12, ST. JAMES'S SQUARE.—Founded in 1841.

Patron—H R H The Prince of Wales.

President—Thomas Carlyle, Esq.

This Library contains 90,000 Volumes of Ancient and Modern Literature, in various Languages. Subscription, £3 a year, or £2 with Entrance Fee of £6; Life Membership, £26.

Fifteen Volumes are allowed to Country, and Ten to Town Members Reading Room open from Ten to half-past Six. Prospectus on application Catalogue, New Edition, in the press.

ROBERT HARRISON, Secretary and Librarian.

A HIGH WRANGLER is anxious to obtain an APPOINTMENT as TUTOR or MATHEMATICAL MASTER in a good School.—Address, T. L. K. M., care of Messrs Macmillan & Co., 29 and 30, Bedford Street, Covent Garden, London, W C.

A CAMBRIDGE B.A., First-class Natural Science Honours and Second-class Classical Honours, desires a TUTORSHIP Natural Science, French, Latin, Greek, Arithmetic. Good references.—A. N. T., care of Editor of Nature, Bedford Street, Strand, W.C.

To ASTRONOMERS and OTHERS.—A skilful Photographer, who is a Chemist and Amateur Astronomer, and possesses also some Literary Ability, wishes for an ENGAGEMENT in which these qualifications would be of service.—D.W., Doctor's Cottages, South Shore, Blackpool.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities.

A LARGE FARMER in one of the Southern Counties of England has a VACANCY for an Articled Pupil Could live with the family.—Apply by letter to Mr. William Rutherford, care of the Editor of NATURE, Bedford Street, Strand, W.C.

A GENTLEMAN who contemplates going to South Africa, sheep-farming, wishes to meet with a Companion with some knowledge of Natural Science and Veterinary Surgery, who would join him, on mutual terms to be agreed upon.—Address "Farmer," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

BEES, Four Hives of, for Sale, in Glass-backed Observatory Hives, 20s. and 25s. each.—A.B., 17, Bellamy Street, Balham.

The SECOND MASTER of a High-class Grammar School receives a few Resident Pupils. Special attention is given to the study of Natural Sciences.—For further particulars apply by letter to "Tripos," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest References can be given.—Address, M.A.H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

WANTED.—SKELETONS of a few of the SMALLER BRITISH BIRDS, to complete a Collection.—Address particulars to F.Z.S., care of Editor of NATURE, Bedford Street, Strand, W.C.

A LADY, who is an accomplished Linguist and Musician, and has a fair acquaintance with the Elements of Natural Science, desires a RE-ENGAGEMENT.—For further particulars, address T. D. P., 9, Elm Road, N.W.

PRIVATE TUITION.—A Gentleman of very great experience with backward and delicate boys, has VACANCIES for THREE PUPILS. Special attention given to the study of the Nature Sciences. Terms reasonable.—Address, F.R.A.S., care of the Publisher of NATURE, Bedford Street, Covent Garden, W.C.

SCIENCE TEACHING by CORRESPON-DENCE. (See past advertisements.) Only time for TWO MORE PUPILS. Address H., care of Macmillan & Co., 29 and 30, Bedford Street, Strand, London, W.C.

TO NATURALISTS and GEOLOGISTS. —The ORFORD CASTLE COLLECTION OF CRAG FOSSILS (See Advertisement in NATURE of June 18th.) For particulars of these Collections address Fredc. Collingwood, Esq., F.G.S., 4, St. Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."

July 8th.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 " ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

NOTICE.—To Science Classes.—MOT-TERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

The determination of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal-measures of Belgium and Somerset.

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft. reached, but as yet without any positive result. The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay; and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance.

Subscriptions may be sent to HENRY WILLETT, Esq., Hon. Sec. and Treasurer, Arnold House, Brighton.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, &c.; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HENRY CROUCH'S

NEW CATALOGUE OF

MICROSCOPES, OBJECTIVES, &c.

With Practical Hints upon the Use of the Accessory Apparatus, fully illustrated, forwarded on receipt of 6 Stamps.

HENRY CROUCH,
66, BARBICAN, LONDON, E.C.,

Nearly opposite Aldersgate Street Station, Metropolitan Railway, near the General Post Office.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O. order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft-cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

MURRAY AND HEATH,

MANUFACTURERS OF

OPTICAL AND SCIENTIFIC INSTRUMENTS

To Her Majesty and the Government Departments,

69, JERMYN STREET, LONDON, S.W.

Students' and other Microscopes, Improved Pocket Microscope, Sole Makers of the Telescopic Microscope Lamp, the Miniature Photographic Apparatus, &c. &c.

New Catalogues forwarded for Six Stamps.

JAMES WOOLLEY, SONS, AND Co.,

69, MARKET STREET, MANCHESTER,

DEALERS IN

CHEMICAL AND SCIENTIFIC APPARATUS, CHEMICAL REAGENTS, &c.,

For the Use of

ANALYSTS, SCIENCE TEACHERS, AND MANUFACTURERS.

Price Lists on Application.

GOLD MEDAL AND HIGHEST AWARDS.

LONDON AND PARIS, 1851, 1862, 1867.

ROSS & CO.,

MANUFACTURING OPTICIANS,

[7, WIGMORE STREET, CAVENDISH SQUARE, W.

Catalogues with full Particulars and Prices of Microscopes, Telescopes, Photographic Lenses and Apparatus, Race, Field, and Opera Glasses, Barometers, Thermometers, Spectacles, &c., may be had on application.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d. } Post-free
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free — per dozen	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3	0	7	6
Ditto traced on blackened Glass, for the Lantern — per slide	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution — £5 5 0

TISLEY AND SPILLER,

OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.

Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

EVERY THURSDAY, PRICE 4*d*.

"NATURE."

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & Co.

OFFICE BEDFORD STREET, STRAND, W.C.

HENRY S. KING & CO.'S LIST.

SENSATION AND INTUITION. Studies in Psychology and Æsthetics. By JAMES SULLY. Demy 8vo, 10s. 6d.

"... In conclusion, we beg to thank Mr. Sully for a meritorious and successful attempt to popularise valuable and not very tractable departments of science."—*Academy.*

The PHYSICS and PHILOSOPHY of the SENSES; or, the Mental and the Physical in their Mutual Relation. By R. S. WYLD, F.R.S.E. Illustrated by several Plates. [Preparing.

The author's object is twofold: first, to supply a Manual of the Senses, embracing the more important discoveries of recent times; second, in discussing the subject of Life, Organisation, Sensibility, and Thought, to demonstrate, in opposition to the materialistic theory, that the Senses, no less than Reason, furnish proof that an immaterial and spiritual element is the operative element in nature.

PROFESSOR ERNST HAECKEL.—The HISTORY of CREATION, a Popular Account of the Development of the Earth and its Inhabitants, according to the Theories of Kant, Laplace, Lamarck, and Darwin. Translated by E. RAY LANKESTER, M.D. With Coloured Plates and Genealogical Trees of the various Groups of both Plants and Animals. 2 vols. post 8vo. [Preparing.

Dr. W. B. CARPENTER's PRINCIPLES of MENTAL PHYSIOLOGY. With their Applications to the Training and Discipline of the Mind, and the Study of its Morbid Conditions. Post 8vo, Illustrated, 12s.

"This valuable book . . . Let us add that nothing we have said, or in any limited space could say, would give an adequate conception of the valuable and curious collection of facts bearing on morbid mental conditions, the learned physiological exposition, and the treasure-house of useful hints for mental training, which make this large and yet very amusing as well as instructive book an encyclopædia of well-classified and often very startling psychological experiences."—*Spectator.*

ENGLISH PSYCHOLOGY, CONTEMPORARY. From the French of Professor Th. RIBOT. Large post 8vo, price 9s. An Analysis of the Views and Opinions of the following Metaphysicians, as expressed in their writings:—

James Mill, Alexander Bain, John Stuart Mill, George H. Lewes, Herbert Spencer, Samuel Bailey.

"The task which M. Ribot set himself, he has performed with very great success."—*Examiner.*

PHYSIOLOGY for PRACTICAL USE. By various Writers. Edited by JAMES HINTON. 2 vols. crown 8vo, with 50 Illustrations, 12s. 6d.

"We never saw the popular side of the science of Physiology better explained than in these two volumes."—*Standard.*

THE INTERNATIONAL SCIENTIFIC SERIES.

1. Fourth Edition, 5s. Professor Tyndall's Forms of Water in Clouds and Rivers, Iceland Glaciers, &c. Illustrated.
2. Second Edition, 4s. Walter Bagehot's Physics and Politics.
3. Second Edition, 5s. Dr. Edward Smith's Foods. Illustrated.
4. Third Edition, 4s. Prof. Bain's Mind and Body. Illustrated.
5. Third Edition, 5s. Herbert Spencer's Study of Sociology.
6. Second Edition, 5s. Prof. Balfour Stewart's Conservation of Energy. Illustrated.
7. Second Edition, 5s. Dr. J. Bell Pettigrew's Animal Locomotion. Illustrated.
8. Second Edition, 5s. Dr. Henry Maudsley's Responsibility in Mental Disease.
9. Second Edition, Illustrated, 5s. Prof. Josiah P. Cooke's New Chemistry.
10. Second Edition, 5s. Prof. Sheldon Amos's Science of Law.
11. Prof. E. J. Marey's Animal Mechanism. Illustrated. [Shortly.
12. Dr. Herman Vogel's Chemical Effects of Light and Photography. Illustrated [In the press.

HENRY S. KING & CO., 65, Cornhill, and 12, Paternoster Row.

CLARENDON PRESS PUBLICATIONS.

A TREATISE ON ELECTRICITY AND MAGNETISM. By J. CLERK MAXWELL, M.A. F.R.S., Professor of Experimental Physics in the University of Cambridge. 2 vols. 8vo, £1 11s. 6d.

The GEOLOGY of the VALLEY of the THAMES. By JOHN PHILLIPS, M.A. F.R.S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo, 21s.

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum.*

VESUVIUS. By John Phillips, M.A., F.R.S. With numerous Maps and Illustrations. Crown 8vo, 10s. 6d.

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction. His plan has been successfully carried out, and has resulted in a work of high value."—*Pall Mall Gazette.*

DESCRIPTIVE ASTRONOMY. A Handbook for the General Reader, and also for practical Observatory work. With 224 Illustrations and numerous Tables. By G. F. CHAMBERS, F.R.A.S., Barrister-at-Law. Demy 8vo, cloth, 856 pp., price 21s.

CHEMISTRY FOR STUDENTS. By A. W. WILLIAMSON, Phil. Doc. F.R.S., Professor of Chemistry, University College, London. New Edition, with Solutions. Extra fcap. 8vo, cloth, price 8s. 6d.

EXERCISES IN PRACTICAL CHEMISTRY. By A. G. VERNON HARCOURT, M.A. F.R.S., Senior Student of Christ Church, and Lee's Reader in Chemistry; and H. G. MADAN, M.A., Fellow of Queen's College, Oxford. Series I., Qualitative Exercises. Second Edition. Crown 8vo, price 7s. 6d.

AN ELEMENTARY TREATISE ON HEAT. By BALFOUR STEWART, LL.D. F.R.S., Professor of Natural History in Owens College, Manchester. Ext. fcap. 8vo, with numerous Woodcuts and Diagrams, 7s. 6d. New Edition, revised and enlarged.

"The publication of this manual is exceedingly well-timed; it includes within narrow limits the leading facts and principles of this younger-born of the Sciences, and for the mastery of the greater portion of the contents only requires ordinary intelligence on the part of the reader."—*Spectator.*

FORMS OF ANIMAL LIFE. Being Outlines of Zoological Classification based upon Anatomical Investigation, and illustrated by Descriptions and Specimens and of Figures. By G. ROLLESTON, M.D. F.R.S., Linacre Professor of Physiology, Oxford. Demy 8vo, price 16s.

A TREATISE on ACOUSTICS. By W. J. DONKIN, F.R.S., Savilian Professor of Astronomy in the University of Oxford. Crown 8vo, price 7s. 6d.

A SYSTEM OF PHYSICAL EDUCATION: Theoretical and Practical. With 346 Illustrations drawn by A. MACDONALD, of the Oxford School of Art. By ARCHIBALD MACLAREN, The Gymnasium, Oxford. Ext. fcap. 8vo, price 7s. 6d.

"The work before us is one which should be in the hands of every schoolmaster and schoolmistress. It is marked in every line by good sense, and is so clearly written that no one can mistake its rules."—*Lancet.*

ELEMENTS OF NATURAL PHILOSOPHY. By Sir W. THOMSON, LL.D. D.C.L. F.R.S., Professor of Natural Philosophy, Glasgow: and P. G. TAIT, M.A., Professor of Natural Philosophy, Edinburgh. Part I, 8vo, 9s.

Oxford: Printed at the Clarendon Press, and Published by MACMILLAN & CO., London, Publishers to the University.

SCIENTIFIC WORKS PUBLISHED BY J. & A. CHURCHILL.

CHEMISTRY, INORGANIC & ORGANIC: with Experiments. By CHARLES L. BLOXAM, Professor of Chemistry in King's College, London, Professor of Chemistry in the Department for Artillery Studies, Woolwich. Second Edition. With 295 Engravings on Wood. 8vo, 16s.

By the same Author.

LABORATORY TEACHING; or, Progressive Exercises in Practical Chemistry, with Analytical Tables. Third Edition. With 89 Engravings, crown 8vo, 5s. 6d.

PRACTICAL CHEMISTRY, including ANALYSIS. By JOHN E. BOWMAN and C. L. BLOXAM. Sixth Edition. With 98 Engravings on Wood, fcap. 8vo, 6s. 6d.

NOTES for STUDENTS in CHEMISTRY: being a Syllabus of Chemistry and Practical Chemistry. By ALBERT J. BERNAYS, Professor of Chemistry at St. Thomas's Hospital. Fifth Edition, revised. Fcap 8vo, 3s 6d.

A MANUAL of ELEMENTARY CHEMISTRY, Theoretical and Practical. By G FOWNES, F R.S. Edited by HENRY WATTS, B A. F.R S. Eleventh Edition. With 163 Wood Engravings, crown 8vo, 15s

FRESENIUS' QUALITATIVE ANALYSIS Translated by ARTHUR VACHER. Eighth Edition, with Coloured Plate and Wood Engravings, 8vo, 12s. 6d.

Also,

FRESENIUS' QUANTITATIVE ANALYSIS. Sixth (reprint of the 4th) Edition. With 186 Wood Engravings, 8vo, 18s.

The FIRST STEP in CHEMISTRY. By ROBERT GALLOWAY, Professor of Applied Chemistry in the Royal College of Science for Ireland. Fourth Edition, with Engravings, fcap. 8vo, 6s 6d.

By the same Author

A MANUAL of QUALITATIVE ANALYSIS. Fifth Edition, with Engravings, post 8vo, 8s 6d.

FIRST PRINCIPLES of MODERN CHEMISTRY By U J KAY-SHUTTLEWORTH, M P. Second Edition, crown 8vo, 4s. 6d.

INTRODUCTION to INORGANIC CHEMISTRY. By WM. G. VALENTIN, F C.S, Principal Demonstrator of Practical Chemistry in the Royal School of Mines and Science Training Schools, South Kensington. With 82 Engravings, 8vo, 6s. 6d.

By the same Author.

QUALITATIVE CHEMICAL ANALYSIS. With 19 Engravings, 8vo, 7s. 6d. (The Tables separately, 2s. 6d.)

HANDBOOK of CHEMICAL TECHNOLOGY. Containing Chemical Metallurgy, Alloys, and Preparations made and obtained from Metals; Crude Materials and Products of Chemical Industry; Glass, Ceramic Ware, Gypsum, Lime, Mortar; Vegetable Fibres, Animal Substances, Dyeing and Calico Printing, Artificial Light; Fuel and Heating Apparatus. By RUDOLF WAGNER, Professor at the University of Wurtzburg. Translated from the Eighth Edition, with Additions, by WILLIAM CROOKES, F.R.S. With 336 Engravings, 8vo, 25s.

The HUMAN EYE, with Remarks on the Eyes of Inferior Animals, a Popular Description. By W. WHALLEY, M R C.S. With 40 Engravings, fcap. 8vo, 3s

FOOD and DIETETICS Physiologically and Therapeutically Considered. By F. W PAVY, M D F R S, Physician to, and Lecturer on Physiology at, Guy's Hospital. 8vo, 16s.

OZONE and ANTOZONE: their History and Nature.

WHEN,
WHERE,
WHY,
HOW,
IS OZONE OBSERVED IN THE ATMOSPHERE?

By CORNELIUS B FOX, M.D. M.R C.P Lond, Fellow of the British, and Member of the Scottish, Meteorological Societies. With Wood Engravings, Lithographs, and Chromo-lithographs, 8vo, 12s 6d

COOLEY'S CYCLOPÆDIA of PRACTICAL Receipts, Processes, and Collateral Information in the Arts, Manufactures, Professions, and Trades, including Pharmacy and Domestic Economy and Hygiène. Designed as a General Book of Reference for the Manufacturer, Tradesman, Amateur, and Heads of Families. Fifth Edition, Revised and partly Re-written by Professor RICHARD V. TUSON, F C.S., assisted by several Scientific Contributors. 8vo, 28s.

A MANUAL of BOTANY: including the Structure, Functions, Classifications, Properties, and Uses of Plants. By ROBERT BENTLEY, F L.S., Professor of Botany, King's College, and to the Pharmaceutical Society. Third Edition, with 1,138 Wood Engravings, crown 8vo, 14s.

The MICROSCOPE and its REVELATIONS, By W B CARPENTER, M.D F.R.S. Fifth Edition, with more than 500 Wood Engravings, crown 8vo. [In the press

A MANUAL of MICROSCOPIC MOUNTING; with Notes on the Collection and Examination of Objects. By JOHN H MARTIN, Author of "Microscopic Objects" With upwards of 100 Engravings, 8vo, 7s 6d.

The QUARTERLY JOURNAL of MICROSCOPICAL SCIENCE (Established in 1852) Edited by J. F PAYNE, M D, Assistant-Physician at St Thomas's Hospital; E RAY LANKESTER, M A., Fellow of Exeter College, Oxford, and W. T. THISELTON DYER, M A. B Sc, Professor of Botany to the Royal Horticultural Society. (Annual Subscription, 16s., Single Numbers, 4s)

HANDBOOK for the PHYSIOLOGICAL LABORATORY By E KLEIN, M D., Assistant-Professor in the Pathological Laboratory of the Brown Institution, London; J. BURDON-SANDERSON, M.D. F.R S., Professor of Practical Physiology in Trinity College, London, MICHAEL FOSTER, M A M.D. F R S, Prelector of Physiology in Trinity College, Cambridge, and J LAUDER BRUNTON, M D. D.Sc, Lecturer on Materia Medica at St Bartholomew's Hospital. Edited by J. BURDON-SANDERSON Two volumes, with 123 Plates, 8vo, 24s.

The THANATOPHIDIA of INDIA; being a Description of the Venomous Snakes of the Indian Peninsula With an Account of the Influence of their Poison on Life, and a Series of Experiments. By J FAYRER, M D C S.I, Honorary Physician to the Queen, late President of the Asiatic Society of Bengal. Second Edition, with 31 Plates (28 coloured), folio, £7 7s

CHAUVEAU'S COMPARATIVE ANATOMY of the DOMESTICATED ANIMALS Translated from the Second French Edition, and edited by GEORGE FLEMING, F R G S., Veterinary Surgeon, Royal Engineers With 450 Engravings on Wood, 8vo, £1 11s 6d.

A MANUAL of the ANATOMY of VERTEBRATE ANIMALS. By Prof. HUXLEY, LL D. F.R S. With numerous Engravings, fcap. 8vo, 12s.

By the same Author

INTRODUCTION to the CLASSIFICATION of ANIMALS. With Engravings, 8vo, 6s

NOTES on COMPARATIVE ANATOMY; a Syllabus of a Course of Lectures delivered at St Thomas's Hospital By WILLIAM MILLER ORD, M.B Lond, M R.C P, Assistant-Physician to the Hospital, and Lecturer in its Medical School. Crown 8vo, 5s

The STUDENT'S GUIDE to *ZOOLOGY*. By ANDREW WILSON, Lecturer on Zoology, Edinburgh. With Engravings, 6s. 6d

NOTES on NATURAL PHILOSOPHY, By G F RODWELL, F.R.A S., Science Master in Marlborough College, late Lecturer on Natural Philosophy in Guy's Hospital With 48 Wood Engravings, fcap 8vo, 5s

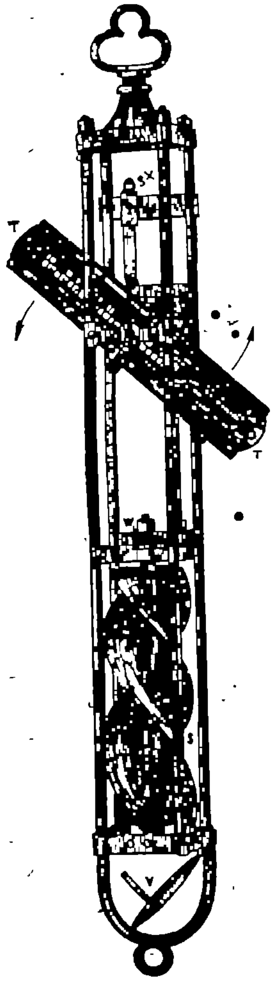
The ELEMENTS of NATURAL PHILOSOPHY. By CHARLES BROOKE, M B M A F R S Based on the work of the late Dr GOLDING BIRD. Sixth Edition, with 700 Engravings on Wood, fcap 8vo, 12s 6d

An INTRODUCTION to PHYSICAL MEASUREMENTS; with Appendices on Absolute Electrical Measurements, &c. By Dr. F KOHLRAUSCH Translated from the Second German Edition by T H. WALLER, B A B Sc, and H. S PROCTER, F.C S With Engravings, 8vo, 12s.

HARDWICH'S MANUAL of PHOTOGRAPHY. By GEORGE DAWSON, M A. Ph D Lecturer on Photography in King's College, London. Eighth Edition, with Engravings, fcap, 8vo, 5s 6d.

A MANUAL of PHOTOGRAPHIC MANIPULATION. By LAKE PRICE. Second Edition, Revised and Enlarged, with numerous Engravings, crown 8vo, 6s 6d.

J. & A. CHURCHILL, NEW BURLINGTON STREET.



NEGRETTI & ZAMBRA'S
PATENT
RECORDING AND DEEP-SEA THERMOMETER.

THIS Thermometer differs from all other Registering or Recording Thermometers in the following important particulars :—

I.—The Thermometer contains only mercury, without any admixture of alcohol or other fluid.

II.—It has no indices or springs, and its indications are by the column of mercury.

III.—It can be carried in any position, and cannot possibly be put out of order, except by actual breakage of the instrument.

And, lastly, it will indicate and record the exact temperature, at any depth of the sea, irrespective of either warm or cold current or stratum through which the Thermometer may have to pass in its descent or ascent. This last qualification renders this Instrument vastly superior to the Thermometers now in use in the *Challenger* and other Deep-sea Expeditions; for, *under certain conditions of temperature*, the old Thermometers on "SIXES" principle have failed to give correct results. This we have on the authority of a Report to the Admiralty by Captain G. S. Nares, of H.M.S. *Challenger*, where, in speaking of temperature near the pack edge of the ice, he says :—

"*At a short distance from the pack the surface water rose to* 32°, *but at a depth of* 40 *fathoms we always found the temperature to be* 29°; *this continued to* 300 *fathoms, the depth in which most of the icebergs float, after which there is a stratum of slightly warmer water of* 33° *or* 34°. *As the Thermometers had to pass through these two belts of water before reaching the bottom, the indices registered those temperatures, and it was impossible to obtain the exact temperature of the bottom whilst near the ice.*"

This new Recording Thermometer, in connection with a simple clock, will also give the exact temperature of the air at any hour of the day or night, a most important addition to our Meteorological Instruments, especially to observers in many parts of the world who are engaged in taking simultaneous observations with our own at fixed Greenwich time.—Illustrations and Prices for this form of the Instrument upon application.

NEGRETTI & ZAMBRA,
OPTICIANS AND METEOROLOGICAL INSTRUMENT MAKERS TO THE ROYAL OBSERVATORY, THE BRITISH AND FOREIGN GOVERNMENTS,
Holborn Viaduct; 122, Regent Street; & 45, Cornhill, London.

VICHY WATERS COMPANY,
27, MARGARET STREET, REGENT STREET, LONDON, W.
DEPOT FOR ALL FOREIGN MINERAL WATERS, VICHY.

The use of the Natural Waters of Vichy is extending vastly. They are most efficacious in all complaints arising from acidity. They make the blood more alkaline and less coagulable, and promote its circulation. In the derangement of the digestive functions, and in all the chronical disorders of the abdominal organs, their good effects are shown. The Waters of Vichy are alkaline and gaseous, and although medicinal they are agreeable to the palate, from their slightly acid taste. Of all mineral waters they are the most exported.

WORKS BY THE LATE PROFESSOR PHILLIPS, F.R.S.

The GEOLOGY of the VALLEY of the THAMES. By John Phillips, M.A., F.R.S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo. 21*s.*

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum.*

VESUVIUS. By John Phillips, M.A. F.R.S. With numerous Maps and Illustrations. Crown 8vo. 10*s.* 6*d.*

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction. His plan has been successfully carried out, and has resulted in a work of high value."—*Pall Mall Gazette.*

Oxford: Printed at the CLARENDON PRESS, and Published by MACMILLAN & CO., London, Publishers to the University

WORKS BY JOHN TYNDALL, LL.D. D.C.L. F.R.S.

Professor of Natural Philosophy in the Royal Institution of Great Britain.

LECTURES on LIGHT, DELIVERED in the UNITED STATES of AMERICA in the years 1872 and 1873. With a Lithographic Frontispiece and 59 Diagrams engraved on Wood. Crown 8vo. price 7*s.* 6*d.*

NOTES of a COURSE of NINE LECTURES on LIGHT, delivered at the Royal Institution of Great Britain, A D. 1869. Crown 8vo, price 1*s.* sewed, or 1*s.* 6*d.* cloth.

NOTES of a COURSE of SEVEN LECTURES on ELECTRICAL PHENOMENA AND THEORIES, delivered at the Royal Institution of Great Britain, A.D. 1870. Crown 8vo. price 1*s.* sewed; 1*s.* 6*d* cloth.

CONTRIBUTIONS to MOLECULAR PHYSICS in the DOMAIN of RADIANT HEAT; a Series of Memoirs published in the "Philosophical Transactions" and "Philosophical Magazine," with Additions. With 2 Plates and 31 Woodcuts. 8vo. price 16*s.*

SOUND: A Course of Eight Lectures delivered at the Royal Institution of Great Britain. Second Edition, revised; with a Portrait of M. Chladni, and 169 Woodcut Illustrations. Crown 8vo. price 9*s.*

HEAT a MODE of MOTION. Fourth Edition, with Alterations and Additions; a Plate and 108 Woodcuts. Crown 8vo. price 10*s.* 6*d.*

RESEARCHES ON DIAMAGNETISM and MAGNE-CRYSTALLIC ACTION; including the Question of Diamagnetic Polarity. With Six Copper Plates and numerous Woodcut Illustrations. 8vo. price 14*s.*

HOURS of EXERCISE in the ALPS. Third Edition; with Seven Woodcut Illustrations by E. WHYMPER. Crown 8vo. price 12*s.* 6*d.*

FARADAY as a DISCOVERER. New and Cheaper Edition, with Two Portraits. Fcp. 8vo. price 3*s.* 6*d.*

FRAGMENTS OF SCIENCE. Fourth Edition, revised. 8vo. price 14s.

London: LONGMANS & CO.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and FLESH-FORMING QUALITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading. Price 6*d.* per month, or 5*s.* per annum, post-free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOIL, by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

GEOLOGICAL PHOTOGRAPHS FOR THE LANTERN.

A New Series of Slides for Illustrating Lectures upon Geology, consisting of Groups of Fossils, Sections of Strata, &c
Prospectus on Application.

HOW'S STUDENT'S MICROSCOPE, £5 5 0

HOW'S MICROSCOPE LAMP.

JAMES HOW, Successor to GEO. KNIGHT and SONS,
2, FOSTER LANE, LONDON.

ENGLISH CATALOGUE.

BOOK-BUYERS *wishing to obtain the fullest information respecting any Work published during the Years* 1863-1871 *inclusive, should order immediately the New Volume, just published, of*

The English Catalogue of Books

Published in Great Britain and the Colonies during 1863 to 1871 inclusive,

COMPRISING ALSO

THE MOST IMPORTANT AMERICAN PUBLICATIONS.

This Volume, occupying over 450 pages, shows the Titles of 32,000 NEW BOOKS and NEW EDITIONS issued during Nine Years, with the Size, Price, and Publisher's Name; the Lists of LEARNED SOCIETIES, PRINTING CLUBS, and other LITERARY ASSOCIATIONS, and the Books issued by them, as also the PUBLISHERS' SERIES and COLLECTIONS—altogether forming an indispensable adjunct to the Bookseller's Establishment, as well as to every Learned and Literary Club and Association. 30s. half bound.

BOOK-BUYERS *seeking information respecting any Work published during the Years* 1835-1862 *inclusive, should buy the previous Volume of*

The English Catalogue,

Of which only a few copies remain on sale. Strongly half-bound, price 45s.

BOOK-BUYERS *may also obtain the*

Index Volume to the English Catalogue, 1835-1862,

In which they will find a complete classification of all the Works in that Catalogue arranged alphabetically on a novel, simple, and most convenient plan, which will enable the seeker to find at once all needful particulars respecting any Work on any subject he may be in search of. Strongly half-bound, price 26s.

An Index Volume to the English Catalogue, 1863-1871.

Is now in active preparation, and will be ready for publication in the course of a few months.

BOOK-BUYERS *are also respectfully reminded that an*

Annual Supplement to the English Catalogue

Has been published for many years. That for the Year 1873 may now be had.

It contains a COMPLETE LIST, alphabetically arranged, of all the WORKS PUBLISHED DURING the YEAR, and also a COMPLETE INDEX of SUBJECTS, on the same plan as the Index described above. Sent free by post, price 5s.

Supplements, 1863, 1856, 1867, 3s. 6d. each; 1866, 1867 to 1872, 5s. each, may also be had.

BOOK-BUYERS *are invited to subscribe for the*

Publishers' Circular and General Record of British and Foreign Literature;

Giving a transcript of the title-page of EVERY WORK PUBLISHED in GREAT BRITAIN, and EVERY WORK of INTEREST PUBLISHED ABROAD, with Lists of all the Publishing Houses.

Published regularly on the 1st and 15th of every Month, and forwarded post free to all parts of the world on payment of 8s. per annum.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE,
Crown Buildings, 188, Fleet Street.

STANDARD TEXT-BOOKS IN NATURAL SCIENCE.

Just published

A MANUAL OF BOTANY, Anatomical and Physical, for the Use of Students. By ROBERT BROWNE, M.A. Ph.D. F.R.G.S., Lecturer on Botany under the Science and Art Department of the Committee of the Privy Council on Education. Crown 8vo, with numerous Illustrations, 12s. 6d.

A MANUAL of PALÆONTOLOGY, for the Use of Students. With a General Introduction on the Principles of Palæontology. By HENRY ALLEYNE NICHOLSON, M.D. F.R.S.E. F.G.S. &c., Professor of Geology in the Royal College of Science, Dublin. Crown 8vo, with upwards of 400 Engravings, 15s.

INTRODUCTION to the STUDY of BIOLOGY. By the Same. Crown 8vo, with numerous Engravings, 5s.

A MANUAL of ZOOLOGY, for the Use of Students. With a General Introduction on the Principles of Zoology. By the Same. Third Edition. Crown 8vo, pp 706, with 280 Engravings on Wood, 12s. 6d.

TEXT-BOOK of ZOOLOGY, for the Use of Schools. By the Same. Second Edition, enlarged. Crown 8vo, with 188 Engravings on Wood, 6s.

ECONOMIC GEOLOGY; or, Geology in its Relations to the Arts and Manufactures. By DAVID PAGE, LL.D. F.G.S. &c., Professor of Geology in the Durham University College of Physical Science, Newcastle. [In the press.

GEOLOGY for GENERAL READERS. A Series of Popular Sketches in Geology and Palæontology. By the Same. Third Edition, enlarged, 6s.

HANDBOOK of GEOLOGICAL TERMS, GEOLOGY, and PHYSICAL GEOGRAPHY. By the Same. Second Edition, enlarged, 7s. 6d.

INTRODUCTORY TEXT-BOOK of GEOLOGY. By the Same. With Engravings on Wood, and Glossarial Index. Tenth Edition, 2s. 6d.

ADVANCED TEXT-BOOK of GEOLOGY. Descriptive and Industrial. By the Same. With Engravings, and Glossary of Scientific Terms. Fifth Edition, revised and enlarged, 7s. 6d.

WM. BLACKWOOD & SONS, Edinburgh and London.

AN ELEMENTARY TREATISE ON STEAM. By JOHN PERRY, B.E., Whitworth Scholar, F.C.S., late Lecturer on Physics at Clifton College. 4s. 6d.

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light. The numerous examples and exercises will prove useful in all Physics classes; whether the whole course is followed or not; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's Hill.

MACMILLAN & CO., LONDON.

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY, 1841–1872, is now ready, including both Authors' Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5s., by post 5s 4d; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10s.

The JOURNAL of the CHEMICAL SOCIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1s.

Ready this day, royal 8vo, 764 pp., cloth, with over 200 Illustrations, price 34*s.*

ELEMENTS OF METALLURGY:

A PRACTICAL TREATISE ON THE ART OF EXTRACTING METALS FROM THEIR ORES.

By J. ARTHUR PHILLIPS, M. Inst. C.E., F.G.S., F.C.S., &c.

Ancien Elève de l'Ecole des Mines, Paris; Author of "Mining and Metallurgy of Gold and Silver," &c.

"Will be eagerly sought for by Students in Science and Art, as well as by practical workers in metals."—*Colliery Guardian.*

"The value of this work is almost inestimable."—*Mining Journal.*

London: CHARLES GRIFFIN & CO., 10, Stationers' Hall Court.

BROWNING'S MINIATURE SPECTROSCOPE.

Dimensions: $\frac{7}{16}$ diameter, 3 inches long.

This Instrument will show many of Fraunhofer's lines, the bright lines of the metals and gases, and the absorption bands in coloured gases, crystals, or liquids.

Price, with five prisms	£1 2 0
Ditto, with adjustable slit	1 13 0

THE "POPULAR" SPECTROSCOPE.

This Instrument, now for the first time introduced, is a perfect instrument for the use of Chemists, or in cases where very great dispersive power is desirable. The Instrument has a prism of extra dense flint glass; the Telescopes have achromatic object-glasses; the Circle is divided to read to single minutes, and the whole of the Stand is of brass, highly finished, in Cabinet complete.

Price £5 0 0

JOHN BROWNING,

OPTICAL AND PHYSICAL INSTRUMENT MAKER

To Her Majesty's Government, the Royal Society, the Royal Observatories of Greenwich and Edinburgh, &c. &c.

63, STRAND, W.C., LONDON.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116 NATURE Office, 29, Bedford Street, Strand, W.C.

"NATURE."

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

Just published, free for one stamp

THE NATURAL HISTORY and SCIENTIFIC BOOK CIRCULAR, No. 9, JULY, containing Valuable Works on Botany, Chemistry, Conchology, Entomology, General Natural History Geology, Meteorology, Ornithology, &c.—WM. WESLEY, 28, Essex Street Strand, London.

A FEW ARTIST'S PROOFS

OF THE

PORTRAIT of PROF. TYNDALL, F.R.S., D.C.L., LL.D.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,
PRICE 5s. EACH,
OR THROUGH ANY BOOKSELLER.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR AUGUST 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.
"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF AUGUST NUMBER—Our Illustrations:—1. "Henry Fawcett, Esq., M.P., and Mrs. Fawcett," by Ford Madox-Brown. 2. "The Knight in Armour," by Wm. Cave Thomas. 3. "Lesson in Network," by J. F. Millet.—The Exhibitions: The Royal Academy, the Munich Gallery.—The Decoration of St. Paul's Cathedral, No. 2.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½*d.*, 1*s.* 1½*d.*, and 2*s.* 9*d.* Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2*s.* 9*d.* box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

*** The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation, and all the symptoms of Impending Consumption.

LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2*s.* 9*d.* by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

*** Order of any Chemist.

E. DENT & CO., 61, Strand, & 34, Royal Exchange

(FACTORY, SAVOY ST.), LONDON.

MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.

MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.

MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.

Catalogues or Estimates on Application.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr Hassall, September 23, 1863; Dr. Lankester, September 30, 1867; Dr Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10s and upwards Portable Filters on this system, £1 5s. to £3

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s each

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4s. 6d to 6s each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,

157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2d.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s. to 45s Alberts, 2s to 5s.; Long Chains, 5s. to 8s. 6d.; Lockets, 2s to 5s. 6d.; Crosses, 1s. 6d. to 4s. 6d., Ladies' Gem Rings, 2s. to 4s; Wedding and Keeper Rings, 1s. to 2s 6d; Gents' Finger Rings, 2s 6d. to 6s, Bracelets, 5s to 10s. 6d: Studs, 1s to 3s 6d; Links, 1s to 3s, Breast Pins, 1s. to 4s 6d, Brooches, 1s. 6d. to 7s. 6d, Ear Rings, 1s. 6d. to 6s. 6d: Sets (*en suite*), Brooch and Ear Rings, 5s. 6d to 10s 6d, Pencil Cases, 2s to 4s 6d.; Gents' Snake Rings (Plain Head), 3s. 6d, Head set with Brilliant, &c, 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "**MAZELINE" GOLD JEWELLERY** to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P.O.O. to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom LIBERAL TERMS.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests, Subscription, 16s 6d. per annum, post free, dating from any quarter-day, Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

HOLLOWAY'S PILLS.—Hale Constitutions.

—The experience of years has shown that when the human frame has become debilitated from the effects of exposure, excess, or neglect, these Pills taken according to the directions will repair the mischief Holloway's Pills exercise the most wonderful tonic properties in all cases of nervous depression, whereby the vital powers are weakened, and the circulation is languid and unsteady. They improve the appetite, strengthen the digestion, regulate the liver, and act as gentle aperients. The Pills are suited to all ages and habits. A patient writes "Your Pills to be valued require only to be known. During many years I sought a remedy in vain, was daily becoming weaker, but when I heard of your Pills, and had recourse to them, they soon restored me"

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations, Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

MESSRS. MACMILLAN AND CO.'S

PUBLICATIONS.

TELEGRAPH and TRAVEL: a Narrative of the Formation and Development of Telegraphic Communication between England and India, under the orders of Her Majesty's Government, with incidental Notices of the Countries through which the Lines pass. By Colonel Sir FREDERIC GOLDSMID, C.B., K.C.S.I., late Director of the Government Indo-European Telegraph. With numerous Illustrations and Maps. 8vo. [*This day.*

TECHNICAL TRAINING. By Thomas Twining, one of the Vice-Presidents of the Society of Arts. Being a Suggestive Sketch of a National System of Industrial Instruction founded on a general diffusion of Practical Science among the People. 8vo. 12*s.* [*This day.*

FIRST FORMS of VEGETATION. By the Rev. Hugh Macmillan, LL.D. F.R.S.E., Author of "Bible Teachings in Nature," &c. Being a New Edition, revised and enlarged, of "Foot-notes from the Page of Nature." With numerous Illustrations. Extra fcap. 8vo. 6*s.* [*This day.*

THE LIFE and LETTERS of JAMES FORBES, F.R.S., late Principal of the University of St. Andrew's. By J. C. SHAIRP, LL.D., Principal of the United College of the University of St. Andrew's; P. G. TAIT, M.A., Professor of Natural Philosophy in the University of Edinburgh; and A. ADAMS REILLY, F.R.G.S. With Portrait, Map, and Illustrations. 8vo. 16*s.*

RENDU'S THEORY of the GLACIERS of SAVOY. Translated by A. Wills, Q.C., late President of the Alpine Club. To which are added, the Original Memoir, and Supplementary Articles by Professors P. G. TAIT and J. RUSKIN. Edited with Introductory Remarks by GEORGE FORBES, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. 8vo. 7*s.* 6*d.*

ELEMENTS of PHYSICAL MANIPULATION. By E. C. Pickering, Thayer Professor of Physics in the Massachusetts Institute of Technology. Part I. Medium 8vo. 10*s.* 6*d.*

FIRST PRINCIPLES of CHEMICAL PHILOSOPHY. By J. P. Cooke, Ervine Professor of Chemistry and Mineralogy in Harvard College. Crown 8vo. 12*s.* Third Edition, revised and corrected.

MANUAL of the CHEMISTRY of the CARBON COMPOUNDS, or ORGANIC CHEMISTRY. By C. SCHORLEMMER, F.R.S. Illustrated. 8vo. 14*s.*

THE PRINCIPLES of SCIENCE: a Treatise on Logic and Scientific Method. By STANLEY JEVONS, F.R.S., Professor of Logic in Owens College, Manchester. 2 vols. 8vo. 25*s.*

ETRUSCAN RESEARCHES. By the Rev. Isaac Taylor, M.A. With Woodcuts. 8vo. 14*s.*

THE DEPTHS of the SEA: an Account of the General Results of the Dredging Cruises of H.M.S. *Lightning* and *Porcupine* during the Summers of 1868, 1869, and 1870, under the scientific direction of Dr. CARPENTER, F.R.S., J. GWYNN JEFFREYS, and Dr. WYVILLE THOMSON, F.R.S., By Dr. WYVILLE THOMSON, F.R.S., Director of the Scientific Staff of the *Challenger* Expedition. With nearly 100 Illustrations, and 8 Coloured Maps and Plans. Second Edition. Medium 8vo, cloth gilt, 31*s.* 6*d.*

THE FORCES of NATURE; a Popular Introduction to the Study of Physical Phenomena. By AMÉDÉE GUILLEMIN. Translated from the French by Mrs. NORMAN LOCKYER, and edited, with Additions and Notes, by J. NORMAN LOCKYER, F.R.S., with 11 Coloured Plates and 455 Woodcuts. Second Edition, medium 8vo. cloth gilt, 31*s.* 6*d.*

CONTRIBUTIONS TO SOLAR PHYSICS. By J. Norman Lockyer, F.R.S. With numerous Illustrations. Medium 8vo. cloth gilt, 31*s.* 6*d.*

SPECTRUM ANALYSIS. By H. E. Roscoe, F.R.S., Professor of Chemistry in Owens College, Manchester. A Series of Lectures with Appendices, Engravings, Maps, and Chromolithographs. Third Edition. Medium 8vo. 21*s.*

MACMILLAN & CO., LONDON.

MESSRS. MACMILLAN AND CO.'S

PUBLICATIONS.

LAY SERMONS, ADDRESSES, and REVIEWS. By Prof. Huxley, F.R.S. Third and Cheaper Edition. Crown 8vo. 7*s*. 6*d*.

CRITIQUES and ADDRESSES. By Prof. Huxley, F.R.S. 8vo. 10s. 6d.

THE BEGINNINGS of LIFE: Being some Account of the Nature, Modes of Origin, and Transformations of Lower Organisms. By H. CHARLTON BASTIAN, M.D., F.R.S. With upwards of 100 Illustrations. 2 vols. crown 8vo. 28*s*.

ON the GENESIS of SPECIES. By St. George Mivart, F.R.S. Second Edition, to which Notes have been added in reference and reply to Darwin's "Descent of Man." With numerous Illustrations. Crown 8vo. 9*s*.

CONTRIBUTIONS to the THEORY of NATURAL SELECTION. By A. Russel WALLACE. A series of Essays. Second Edition, with Corrections and Additions. Crown 8vo. 8*s*. 6*d*.

CALIBAN; THE MISSING LINK. By Daniel Wilson, LL.D., Professor of History and English Literature in University College, Toronto. 8vo. 10*s*. 6*d*.

SIR WILLIAM THOMSON'S PAPERS on ELECTROSTATICS and MAGNETISM. Reprinted. With Illustrations. 8vo. 18*s*.

THE SCIENTIFIC BASES of FAITH. By J. J. Murphy, Author of "Habit and Intelligence." 8vo. 14*s*.

THE MYSTERY of MATTER, and other Essays. By the Rev. J. A. Picton. Crown 8vo. 10*s*. 6*d*.

HANDBOOK of BRITISH FUNGI; with full descriptions of all the Species and Illustrations of the Genera. By M. C. COOKE, M.A. 2 vols. Crown 8vo. 24*s*.

The STUDENT'S FLORA of the BRITISH ISLANDS. By J. D. Hooker, C.B., F.R.S. &c., President of the Royal Society. Globe 8vo. 10*s*. 6*d*.

FIRST BOOK of INDIAN BOTANY. By Daniel Oliver, F.R.S., Professor of Botany in University College, London, and Keeper of the Herbarium and Library at the Royal Gardens, Kew. With numerous Illustrations. Globe 8vo. 6*s*. 6*d*.

TREATISE on BUILDING and ORNAMENTAL STONES of GREAT BRITAIN and FOREIGN COUNTRIES, arranged according to their Geological Distribution and Mineral Characters. With Illustrations of their Application in Ancient and Modern Structures. By E. HULL, M.A. F.R.S., Professor of Geology in the Royal College of Science, Dublin. 8vo. 12*s*.

HEREDITARY GENIUS: an Inquiry into its Laws and Consequences. By Francis GALTON, F.R.S. 8vo. 12*s*.

MICHAEL FARADAY. By J. H. Gladstone, Ph.D., F.R.S. New Edition, with Portrait, engraved by JEENS. Crown 8vo. 4*s*. 6*d*.

The MALAY ARCHIPELAGO; the Land of the Orang Utan and the Bird of Paradise. A Narrative of Travel with Studies of Man and Nature. By ALFRED RUSSEL WALLACE. With numerous Illustrations. New and Cheaper Edition. Crown 8vo. 7*s*. 6*d*.

AT LAST: A Christmas in the West Indies. By the Rev. Charles Kingsley, Canon of Westminster. With numerous Illustrations. Third and Cheaper Edition. Crown 8vo. 6*s*.

MACMILLAN & CO., LONDON.

In demy 8vo, with nearly 200 Illustrations, Seventh Edition, 10s. 6d.

The HEAVENS. By Amedee Guillemin.

Edited by J. NORMAN LOCKYER. An Illustrated Handbook of Popular Astronomy.

RICHARD BENTLEY & SON, New Burlington Street.

New Edition, in crown 8vo. with Illustrations, 6s.

The DAY AFTER DEATH; or, The Future Life as Revealed by Science.

By LOUIS FIGUIER.

RICHARD BENTLEY & SON, New Burlington Street.

Second Edition, with 138 Illustrations, royal 8vo, 25s.

TRAVELS in the AIR.

A Popular Account of Balloon Voyages and Ventures, with recent Attempts to accomplish the Navigation of the Air.

By T. GLAISHER, of the Royal Observatory at Greenwich.

RICHARD BENTLEY & SON, New Burlington Street.

At every Bookseller's.

The WORKS of the late Dr. M'CAUSLAND.

1. ADAM and the ADAMITE; or, The Harmony of Scripture and Ethnology. With Map, crown 8vo, 6s.
2. SERMONS in STONES; or, Scripture Confirmed by Geology. New Edition, with Memoir of the Author. Crown 8vo, Roxburghe binding, 19 Illustrations, 6s.
3. The BUILDERS of BABEL; or, The Confusion of Languages. New Edition, in crown 8vo 6s.

RICHARD BENTLEY & SON, New Burlington Street.

To be obtained at every Bookseller's.

FRANK BUCKLAND'S CURIOSITIES OF NATURAL HISTORY.

The People's Edition, 4 vols. illustrated, 14s.; or separately.
First Series, containing Rats, Serpents, Fishes, Monkeys, &c. 3s. 6d.
Second Series, containing Wild Cats, Eagles, Worms, Dogs, &c. 3s. 6d.
Third and Fourth Series, containing Lions, Tigers, Foxes, Porpoises, &c.
Each volume price 3s. 6d.

RICHARD BENTLEY & SON, New Burlington Street.

The CIRCLE and STRAIGHT LINE. By (KUKLOS) JOHN HARRIS.

Part 1, 8vo, pp. 42, with Plates, cloth	4s.
„ 2, 8vo, pp. 56 „ „	4s.
„ 3, 8vo, pp. 26 „ „	4s.
Supplement, 8vo, pp. 28 „ „	4s.
The above, complete	12s. 6d.

London: TRÜBNER & CO., 57 and 59, Ludgate Hill.

COMPLETION of Mr. SPEDDING'S LIFE of LORD BACON.—The Seventh Volume of the Letters and Life of FRANCIS BACON, including all his Occasional Works, collected and edited by J. SPEDDING, M.A., Hon Fell. Trin. Coll. Camb., with a copious Index, completing the work, is now ready, price 12s.

London: LONGMANS & CO.

The ALPINE CLUB MAP of SWITZERLAND and Adjacent Countries engraved on the Scale of 4 Miles to the Inch, constructed under the superintendence of the Alpine Club, and edited by R. C. NICHOLS, F.S.A. Now ready, complete in Four Sheets, in Portfolio, price 42s. or mounted in a Case, price 52s. 6d. Each Sheet may be had separately, price 12s., or mounted in a Case, price 15s.

London: LONGMANS & CO. and E. STANFORD.
Edinburgh: W. & A. K. JOHNSTON.

Illustrated by 760 Wood Engravings and Three Coloured Plates, medium 8vo, cloth, 18s.

DESCHANEL'S NATURAL PHILOSOPHY: an Elementary Treatise. Translated and edited, with extensive Additions, by J. D. EVERETT, D.C.L. F.R.S., Professor of Natural Philosophy in the Queen's College, Belfast.

Also separately, in Four Parts. limp cloth, 4s 6d. each:—Part I. Mechanics, Hydrostatics, and Pneumatics. Part II. Heat. Part III. Electricity and Magnetism. Part IV. Sound and Light.

⁂ A Series of Problems and an Index to the whole Work are appended to Part IV. and the complete volume. These may be had separately, price 6d.

"Systematically arranged, clearly written, and admirably illustrated; it forms a model work for a class in experimental physics."—*Saturday Review.*

London: BLACKIE & SON, Paternoster Buildings.

Large post 8vo, cloth gilt, price 5s. 6d.

BRITISH MARINE ALGÆ: being a Popular Account of the Seaweeds of Great Britain, their Collection and Preservation. By W. H. GRATTANN. With 205 Illustrations.

Each little picture is a perfect gem of the engraver's art."—*Figaro.*

THE BAZAAR Office, 32, Wellington Street, London, W.C.

The BIRDS of SHETLAND, with Observations on their Habits, Migration, and Occasional Appearance. By the late HENRY L. SAXBY, M.D. Edited by his Brother, the Rev. STEPHEN H. SAXBY, of East Clevedon.

Edinburgh: MACLACHLAN & STEWART.
London: SIMPKIN, MARSHALL, & CO.

Price 14s., with Woodcuts.

ETRUSCAN RESEARCHES, By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 140, South 4th Street, Philadelphia, Pa., U.S.A.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B., F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s.* post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16*s.* 6*d.* bound in cloth): also covers for the volume (price 1*s.*), and back numbers

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c., and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages —

The Flower Garden.
Landscape Gardening
The Fruit Garden.
Garden Structures
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 19*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, W.C.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals.
Monocular, £5, Binocular, £10 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/25 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14*s.*; 4½ in., 17*s.*; 6 in., in Wooden Case, 10*s.*, including a Kew Certificate

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and News-vendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE ZOOLOGIST:

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent, No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

IMPORTANT CORRESPONDENCE.

THE REV. SIR EDWARD R. JODRELL, BART.,

To Messrs. FELTOE AND SONS, 26, Conduit Street, Bond Street, W.

When at Sall I received an Analytical Report of your "Specialité" Sherry, and you must forgive me for saying that at first I regarded the whole matter as a most egregious piece of humbug. Having, however, tasted the Wine in question, and found it most agreeable to the palate, I determined on my own responsibility to have it analysed *for myself*, having fully also determined previously to expose any hoax "pro bono publico," or to give you the benefit of the analysis, should it turn out in your favour. I have the pleasure to forward you Professor Redwood's (of the Pharmaceutical Society of Great Britain) Analysis, which says more than I can express. I am very particular as to the Wine I drink, and as I have been hitherto buying "every-day Sherry" at 60s a dozen, I am rejoiced to find *now* that I can purchase Wine of equal strength and superior bouquet at half that price. This should be known to the "General Public," and you can make any use you deem proper of this letter, and also of Professor Redwood's most elaborate analysis.

Yours faithfully,
(*Signed*) EDWARD REPPS JODRELL.

21, Portland Place, London, December 9th, 1873.

THE REV. SIR E. R. JODRELL.

SIR,—I have completed the Analysis of the sample of Sherry you left with me, and proceed to report the results. Judged by the palate it might be represented as a light, moderately dry Wine, with nothing to object to in its flavour or apparent strength. It is slightly acid to test-paper, and has a specific gravity of 986·8. These characters correspond with those of a sample of reputed good Montilla Sherry, the specific gravity of which was found to be 986·6, and the acidity almost identical with that of your sample.

I proceeded to make a more minute analysis, the results of which were as follows:—

Absolute Alcohol, by Volume	20·0 parts in 100
Free or unneutralised Acid, partly volatile and partly non-volatile	0·54 "
Volatile Acid (acetic acid)	0·1 "
Sugar and Extract	2·5 "
Ash, from incineration of Extract	0·45 "
MINERAL ACID, or inorganic matter, NOT YIELDED BY GRAPE-JUICE	NONE."

THESE RESULTS ARE ALL SATISFACTORY. The proportion of alcohol is that found in the best samples of Sherry; the volatile acid (acetic acid) is not more than is usually present, and the fixed acid is the TRUE ACID OF THE GRAPE, namely, tartaric acid. The ash is not more than it should be, and contains nothing foreign to the grape.

In preparing this Analysis, I have been enabled to observe that the alcohol, when separated from the other constituents of the wine, was PURE IN FLAVOUR AND OF GOOD QUALITY, and that there was NOTHING OBJECTIONABLE in the extract or other products that were separated in the process of analysation.

I am yours truly,
(*Signed*) T. REDWOOD, *Professor of Chemistry to the* PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

5th December, 1873.

ADOPTED AND RECOMMENDED BY NEARLY

TWO THOUSAND PHYSICIANS AND SURGEONS.

The recent Medical Correspondence in the "TIMES" demonstrates how injurious to health is "made-up Sherry," ALCOHOLISED to an UNREASONABLE extent.

MESSRS. FELTOE AND SONS,

By appointment to the Royal Family—established Fifty-nine years—are SOLE PROPRIETORS *and* IMPORTERS *of the*

"SPECIALITÉ" SHERRY,

UNADULTERATED GRAPE-JUICE,

"FREE FROM ACIDITY AND HEAT,"

CERTIFIED AS ABOVE TO BE VOID OF

"MINERAL ACID OR INORGANIC MATTER NOT YIELDED BY GRAPE JUICE."

Has been EXHIBITED as a DIETETIC by Special Permission of the Council in the MUSEUM of the

BRITISH MEDICAL ASSOCIATION.

26, Conduit Street, Bond Street, London; Manchester; and Brighton.

"THE CASH SYSTEM ONLY."

30s. PER DOZEN.

£18 per Quarter Cask, 13 Dozens of Bright Wine in Cask. Carriage paid to any Railway Station in England and Scotland, and to any Port in Ireland.

FELTOE'S "SPECIALITÉ" SHERRY.

"This wine has now maintained its reputation more than three years. Comparing an analysis which we made recently with the analysis of *three years ago*, we are glad to see that it is still an honest, sound wine, *free from acid*, and of excellent quality. *It has attained and deserves a great medical reputation*."—*Medical Record.*

"I have had it tested in my laboratory, and am satisfied that it is a genuine, high-class, natural wine, and free from any admixture or acidity. *Invalids*, and persons who have *gouty* or *uric* acid tendencies, and require wine as a beverage in moderate quantity, will find your 'Specialité' Sherry pure and wholesome."—(Signed) WM. HARDWICKE, M.D.—*Metropolitan Analyst.*

"FELTOE'S 'Specialité' Sherry—a wine which is deservedly making its way chiefly through the recommendations of the *Medical Profession*, founded on its honestly excellent qualities, its *freedom from acidity and heat*, and its uniform soundness."—*British Medical Journal.*

MANZANILLA and MONTILLA, for the *purity* of which Wines MESSRS. FELTOE AND SONS are so renowned, are likewise supplied upon the above terms.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co., at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, August 20, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 252, Vol. 10] THURSDAY, AUGUST 27, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office [All Rights are Reserved.

THE

OWENS COLLEGE, MANCHESTER.

Principal—J. G. Greenwood, LL.D

PROFESSORS AND LECTURERS.

Greek	J. G Greenwood, LL D, Fell. Univ Coll. Lond.
Latin	A. S Wilkins, M A., Fell Univ Coll. Lond
English and History	A W Ward, M A, Fell. St Peter's Coll Camb.
Mathematics	T. Barker, M.A, late Fell Trin. Coll. Camb.
Natural Philosophy	Balfour Stewart, M.A. LL D. F R S T H Core, M A
Engineering	O. Reynolds M A., Fell Queen's Col Camb
Logic and Philosophy Political Economy	W S Jevons, M A. F R.S, Fell. Univ. Coll Camb
Jurisprudence and Law	J. Bryce, D C L., Fell. Oriel Coll. Oxon
Theoretical and Practical Chemistry	Henry E. Roscoe, B.A. Ph.D. F R S.
Organic Chemistry	C Schorlemmer, F.R.S.
Animal Physiology and Botany	W. C. Williamson, F R S.
Practical Physiology and Histology	A. Gamgee, M.D F R S.
Geology	W B Dawkins, M A F.R.S. F.G.S
Mineralogy	C. A. Burghardt, Ph D.
Oriental Languages and German	T. Theodores
French	H Breymann, Ph D.
Freehand Drawing	W. Walker
Harmony	J. F. Bridge, Mus. Doc. Oxon.

With Assistant Lecturers in all the principal Departments.

The next SESSION will commence on the 6th of OCTOBER. Candidates for admission must not be under fourteen years of age, and those under sixteen will be required to pass a preliminary examination in English, Arithmetic, and the Elements of Latin.

Prospectuses of the several Departments of the Day Classes, the Evening Classes, and the Medical School, and of the Scholarships and Entrance Exhibitions tenable at the College, will be sent on application.

J. HOLME NICHOLSON, Registrar.

WESTMINSTER HOSPITAL MEDICAL SCHOOL.

(OPPOSITE WESTMINSTER ABBEY)

The SESSION 1874-75 will commence on THURSDAY, October 1st, with an INTRODUCTORY LECTURE by Dr. Potter The Address will be followed by the Distribution of the Prizes and a Conversazione in the Board Room

The new Physiological Laboratory will be completed by October 1st.

The Examinations for the Entrance Scholarships will be held on the 2nd and 3rd of October.

GEORGE COWELL, Dean.

UNIVERSITY OF LONDON.

MATRICULATION AND PRELIMINARY SCIENTIFIC EXAMINATIONS.

Special Classes for these Examinations are held at St. Bartholomew's Hospital. The Classes are not confined to Students of the Hospital.

A Class for the Matriculation Examination is held twice in each year, from October to January and from March to June

A Class for the Preliminary Scientific Examination is held from January to July.

For particulars, application may be made, personally or by letter, to the Warden of the College, St. Bartholomew's Hospital.

ANDERSON'S UNIVERSITY, GLASGOW.

The Trustees invite CANDIDATES for the CHAIR of CHEMISTRY vacant by the resignation of Professor Thorpe.

Applications to be lodged, on or before the 1st of September, with the Subscriber, who will furnish information regarding the duties and terms of the appointment.

J. B. KIDSTON, Secretary.

50, West Regent Street, Glasgow, 14th August, 1874.

MIDDLESEX HOSPITAL.

ENTRANCE SCHOLARSHIPS.

TWO SCHOLARSHIPS, of the annual value of £25 and £20 respectively, will be competed for on September 28th and following days. These Scholarships are open to all gentlemen who commence their medical studies in October 1874. Successful candidates will be required to become general students of the College.

For full particulars as to subjects of examination, &c, apply to the Dean.

ROBERT KING, B.A. M.B., Dean.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

The WINTER SESSION will begin on THURSDAY, October 1.

The Clinical Practice of the Hospital comprises a service of 740 Beds, inclusive of 34 Beds for Convalescents at Highgate

Students can reside within the Hospital walls, subject to the College regulations.

For all particulars concerning either the Hospital or College, application may be made, personally or by letter, to the Resident Warden of the College

A Handbook will be forwarded on application.

UNIVERSITY COLLEGE, LONDON.

SESSION 1874-5.

The SESSION of the FACULTY of MEDICINE will commence on THURSDAY, October 1. Introductory Lecture at 3 p m , by Dr. F. T. Roberts B Sc.

The SESSION of the FACULTY of ARTS and LAWS (including the Department of the Fine Arts) will begin on Monday, October 5th. Introductory Lecture at 3 p m , by Professor G C Foster, F R.S Introductory Lecture for the Department of Fine Arts, the same day at 4 30 p m., by Professor E J. Poynter, A.R.A.

The SESSION of the FACULTY of SCIENCE (including the Department of the Applied Sciences) will begin on Monday, October 5.

The SCHOOL for BOYS between the ages of Seven and Sixteen will RE-OPEN on Tuesday, September 22

Prospectuses of the various Departments of the College, containing full information respecting Classes, Fees, Day and Hour of Attendance, &c , and copies of the Regulations relating to the Entrance and other Exhibitions, Scholarships, and Prizes open to competition by students of the several Faculties, may be obtained at the Office of the College.

The Examination for the Medical Entrance Exhibitions, and also that for the Andrews Entrance Prizes (Faculties of Arts and Laws, and of Science), will be held at the College on the 24th and 25th of September.

The College is close to the Gower Street Station of the Metropolitan Railway, and only a few minutes' walk from the Termini of the North Western, Midland, and Great Northern Railways.

JOHN ROBSON, B.A.

August 1874. Secretary to the Council.

UNIVERSITY COLLEGE, LONDON.

FACULTY OF SCIENCE.

The SESSION will begin on MONDAY, October 5th, 1874.

Pure Mathematics—Professor O. Henrici, Ph D. F.R S.
Applied Mathematics and Mechanics—Professor W K Clifford, M.A. F.R.S.
Physics—Professor G C Foster, B A. F R S.
Chemistry and Practical Chemistry—Professor Williamson, Ph D F R S.
Mineralogy and Geology—Professor Morris, F G S.
Engineering—Professor A. B W Kennedy, C E
Architecture and Construction—Professor T. Hayter Lewis, F.S.A. F I.B A.
Botany—Professor Oliver, F R S F L S.
Comparative Anatomy and Zoology—Professor Grant, M.D F.R S
Human Physiology (including Practical Physiology and Histology—Professor Burdon-Sanderson, M D F.R S.
Philosophy of Mind and Logic—Professor G. Croom Robertson, M.A.
Political Economy—Professor L. H Courtney, M A.

A Prospectus of the Faculty may be obtained at the Office of the College

The examination for the Andrews Entrance Prizes will be held at the College, on the 24th and 25th September.

The College is close to the Gower Street Station of the Metropolitan Railway.

OHN ROBSON, B.A.
Secretary to the Council.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

Opening of WINTER SESSION, October 1st, 1874. Introductory Address by Mr. EDMUND OWEN.

For further particulars apply to the Registrar at the Hospital, or to

A. B. SHEPHERD, M.B., Dean of the School.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

THREE OPEN SCHOLARSHIPS and TWO EXHIBITIONS, October 1874.

For particulars apply to the Dean, St. Mary's Hospital, Paddington, W.

NOTICE.—ROYAL SCHOOL of MINES,

Jermyn Street, London.—The 24th SESSION will begin on THURSDAY, the 1st October

Prospectuses may be had on application.

TRENHAM REEKS, Registrar.

KING'S COLLEGE, LONDON.

The THEOLOGICAL DEPARTMENT —New Students must present themselves on TUESDAY, September 29.

The College Theological Testamur can be obtained by

A. Graduates in Arts of any British University, in three terms.

B Associates of the General Literary Department of King's College, in six terms

C. All duly qualified persons of 21 years of age, in six terms.

Two Studentships of the value of £30 for two years will be adjudged by examination to those entering the College in October next.

There is also a Preparatory Class for those wishing to pass the Entrance Examinations.

For information, apply, personally or by post-card, to J. W. Cunningham, Esq , Secretary.

KING'S COLLEGE, LONDON.

DEPARTMENT of GENERAL LITERATURE and SCIENCE.—New Students will be admitted on WEDNESDAY, September 30.

The Department is thus divided :—

1. The Classical Division (embracing Classics, Mathematics, English History, and Modern Languages)

2. The Modern Division, which includes English, Latin, Modern Languages, Mathematics, Natural Philosophy, Chemistry, Geology, and Free-hand Drawing.

One Freake Exhibition of £20 will be given at the commencement of the Michaelmas Term to the Student passing the best examination on entering the College.

For information, apply, personally or by post-card, to J.W. Cunningham, Esq , Secretary.

KING'S COLLEGE, LONDON.

DEPARTMENT of ENGINEERING and APPLIED SCIENCES.—New Students will be admitted on WEDNESDAY, September 30.

The course of study provides practical education for young men who intend to engage in engineering, surveying, architecture, telegraphy, and the higher branches of chemical and manufacturing art.

This Department has attached to it a workshop, also chemical, physical, and photographic laboratories

One Freake and two College Exhibitions of £20, £30, and £21 respectively, will be given at the commencement of the Michaelmas Term to the Students passing the best examination on entering the College.

For information, apply, personally or by post-card, to J.W. Cunningham, Esq , Secretary.

KING'S COLLEGE, LONDON.

MEDICAL DEPARTMENT —The WINTER SESSION will OPEN on THURSDAY, October 1, with an Introductory Lecture by Dr. Ferrier.

Warneford Scholarships.—Students entering in October next will have the privilege of contending for two Scholarships of £25 each for three years

Five Medical Scholarships are awarded at the close of each winter session for proficiency in professional subjects, viz., one of £40 for two years, one of £30 for one year, and three of £20 for one year

For further information apply, personally or by post-card, to J. W. Cunningham, Esq , Secretary

---

KING'S COLLEGE, LONDON.

The EVENING CLASSES.—These Classes will RE-OPEN on MONDAY, October 5, in Divinity, Latin, Greek, French, German, Hebrew, Italian, Spanish, German Literature, English History, Geography, Arithmetic, Writing, Mathematics, Commerce, Drawing, Chemistry, Practical Chemistry, Mechanics, Physiology, Physics, Botany, Zoology, Logic, Political Economy, Mineralogy, Geology, Law, and Public Speaking.

For the prospectus, apply, personally or by post-card, to J.W. Cunningham, Esq , Secretary.

KING'S COLLEGE, LONDON.

The SCHOOL.—New Pupils will be admitted on TUESDAY, September 22. There are four divisions :—

1. Upper Classical School, intended to prepare Pupils for the Universities, for the theological, general literature, and medical departments of the College, and for the learned professions.

2. Upper Modern School, intended to prepare Pupils for general and mercantile pursuits, for the department of Engineering in the College, and for the Military Academies.

3 The Middle School comprises several Classes, each with its classical and modern division, for Pupils who are too old for the Lower, but not sufficiently advanced for the Upper School. Great attention is paid in this Division to arithmetic, writing, and bookkeeping, and to the subjects required for the Home Civil Service Examinations and those for mercantile appointments.

4. Lower School —This Division includes boys over eight years of age, and is intended to give a complete course of education up to such a point as will prepare them to enter with advantage either of the two senior divisions.

For information, apply, personally or by post-card, to J.W. Cunningham, Esq , Secretary

ROYAL COLLEGE of SCIENCE for IRELAND, STEPHEN'S GREEN, DUBLIN.

SCIENTIFIC AND TECHNICAL EDUCATION

This College supplies a complete course of instruction in Science, applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course

There are Four Royal Scholarships, of the value of £50 each yearly, with free education, including Laboratory instruction, tenable for two years Two became vacant each year. They are given to Students who have been a year in the College.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory

Chemistry (Theoretical and Practical), Metallurgy, &c.—Professor Robert Galloway, F C.S
Mathematics, Mechanics, and Mechanism—Professor Robert Ball, LL D, F R S
Drawing, Engineering, and Surveying—Professor Thomas F. Pigot, C.E. M R I.A
Experimental Physics—Professor W F. Barrett, F.R S E. F.C S.
Geology—Professor Edward Hull, M.A F.R S.
Mining and Mineralogy—Professor J. P O'Reilly, C E. M.R.I.A.
Agriculture—Professor Edmund W. Davy, M.D. M.R.I.A.
Botany—Professor W R. M'Nab, M D.
Zoology—Professor H. Alleyne Nicholson, M.D.

The Session commences on MONDAY, October 5th.

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D, Secretary.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus, F R S; Dr. Frankland, F R S.; Dr. Roscoe, F.R S; Dr. Angus Smith, F.R.S, Dr. Tyndall, F.R.S.; Dr. Voelcker, F R S.; Dr. Williamson, F R S

The Term commences TUESDAY, September 15

C. WILLMORE, Principal.

GRAMMAR SCHOOL, LEEDS.—Wanted, for September 15, a MATHEMATICAL and SCIENTIFIC MASTER. Non-resident. Salary, £200.—Applications, with Testimonials and References, to be addressed to the Rev. W G. Henderson, D.C.L., Head Master.

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

The determination of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal measures of Belgium and Somerset

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft reached, but as yet without any positive result The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay; and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance

Subscriptions may be sent to Henry Willett, Esq, Hon. Sec. and Treasurer, Arnold House, Brighton.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. Nature Office, 29, Bedford Street, Strand, W.C

ROYAL COUNCIL OF EDUCATION.— The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate Analyses and investigations conducted—Apply to Prof. E. V. Gardner, F.E.S., F.S A., 44, Berners Street, W

SCIENCE TEACHING by CORRESPONDENCE. (See past advertisements) Only time for TWO MORE PUPILS Address H, care of Macmillan & Co., 29 and 30, Bedford Street, Strand, London, W.C.

PRIVATE TUITION.—A Gentleman of very great experience with backward and delicate boys, has VACANCIES for THREE PUPILS. Special attention given to the study of the Nature Sciences Terms reasonable—Address, F R A S, care of the Publisher of Nature, Bedford Street, Covent Garden, W C.

A LADY, who is an accomplished Linguist and Musician, and has a fair acquaintance with the Elements of Natural Science, desires a RE-ENGAGEMENT.—For further particulars, address T. D. P, 9, Elm Road, N.W.

A HIGH WRANGLER is anxious to obtain an APPOINTMENT as TUTOR or MATHEMATICAL MASTER in a good School—Address, T. L. K M, care of Messrs Macmillan & Co., 29 and 30, Bedford Street, Covent Garden, London, W C

A CAMBRIDGE B.A., First-class Natural Science Honours and Second-class Classical Honours, desires a TUTORSHIP Natural Science, French, Latin, Greek, Arithmetic. Good references.—A N. T, care of Editor of Nature, Bedford Street, Strand, W.C.

The SECOND MASTER of a High-class Grammar School receives a few Resident Pupils Special attention is given to the study of Natural Sciences—For further particulars apply by letter to "Tripos," care of the Publisher of Nature, 29, Bedford Street, Strand, London, W.C.

TO NATURALISTS and GEOLOGISTS. —The ORFORD CASTLE COLLECTION OF CRAG FOSSILS (See Advertisement in Nature of June 18th) For particulars of these Collections address Fredc. Collingwood, Esq, F.G S, 4, St Martin's Place, Trafalgar Square, superscribed "Orford Castle Fund"

July 8th.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV From 10s. each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s; Ladies' Chest Expanders from 5s 6d. SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints, and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d, sent for P.O order.—ALEX ROSS, 248, High Holborn, London, and all Chemists

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain Price 10s 6d, sent carriage-free for P O. order.—ALEX ROSS, 248, High Holborn, London Pamphlet sent for two stamps

ZOOLOGICAL SOCIETY OF LONDON.

LIST OF DUPLICATE ANIMALS

IN THE

GARDENS FOR SALE.

AUGUST, 1874.

MAMMALS.

		£	s.	d.
1	Pair Collared Fruit Bats (Cynonycteris collaris)	10	0	0
1	Civet Cat, female (Viverra civetta)	10	0	0
1	Sumatran Civet (Viverra tangalunga)	8	0	0
1	Common Paradoxure (Paradoxurus typus)	1	10	0
1	Black-backed Jackal, male (Canis mesomelas)	2	0	0
1	Tayra (Galictis barbara)	6	0	0
1	Ratel (Mellivora indica)	10	0	0
2	Common Raccoons (Procyon lotor), the pair	5	0	0
2	Coatis (Nasua nasica), the pair	3	0	0
1	Kinkajou (Cercoleptes caudivolvulus), each	4	0	0
1	Brown Bear, male (Ursus arctos)	8	0	0
2	Himalayan Bears (Ursus tibetanus), each	10	0	0
2	Octodons (Octodon cumingi), each	0	10	0
2	Barbary Wild Sheep, male and female (Ovis tragelaphus), the pair	30	0	0
1	Zebu, female (Bos indicus)	20	0	0
1	Cape Buffalo, male (Bubalus caffer)	80	0	0
1	Molucca Deer, male (Cervus moluccensis)	12	0	0
1	Prince Alfred's Deer, male (Cervus alfredi)	40	0	0
2	Virginian Deer, male and female (Cervus virginianus), the pair	12	0	0
2	Mauge's Dasyures, females (Dasyurus maugei), each	1	10	0
4	Vulpine Phalangers, males (Phalangista vulpina), each	1	5	0
1	Great Kangaroo, male (Macropus giganteus)	25	0	0
2	Great Kangaroos, male and female, young (Macropus giganteus), each	20	0	0
2	Red Kangaroos, males (Macropus rufus), each	30	0	0

BIRDS.

		£	s.	d.
1	Laughing Kingfisher (Dacelo gigantea)	1	10	0
2	Crested-Ground Parrakeets (Calopsitta novæ hollandiæ), each ...	1	0	0
1	Greater Sulphur-crested Cockatoo (Cacatua galerita)	2	10	0
1	Leadbeaters Cockatoo (Cacatua leadbeateri)	3	0	0
1	Blue-crowned Conure (Conurus hæmorrhous)	1	10	0
3	Ring-necked Parrakeets (Palæornis torquata), each	1	0	0
2	Black Vultures (Cathartes atratus), each	4	0	0
1	Griffon Vulture (Gyps fulvus)	8	0	0
2	Brazilian Caracaras (Polyborus brasiliensis), each	2	0	0
2	Black Kites (Milvus migrans), each	2	0	0
2	Common Buzzards (Buteo vulgaris), each	0	15	0
2	Bateleur Eagles (Helotarsus ecaudatus), each	6	0	0
1	Chilian Sea Eagle (Geranoaetus aguia)	4	0	0
2	Common Herons (Ardea cinerea), each	0	10	0
1	Black-necked Swan (Cygnus nigricollis)	20	0	0
1	Wattled Crane (Grus carunculata)	40	0	0
2	Cape Crowned Cranes (Balearica regulorum), each	20	0	0
1	Earle's Weka Rail (Ocydromus earlei)	5	0	0

REPTILES.

		£	s.	d.
2	Young Mississippi Alligators (Alligator mississippiensis), each ...	2	0	0

The Animals may be viewed on application to the Superintendent at the Gardens.

The Animals will be delivered to Purchasers at the Society's Gardens. They can be packed and forwarded for the convenience of Purchasers, but in such cases the packing-cases will be charged for unless returned, and the animals will be at the Purchaser's risk during transit.

Applications by letter should be addressed to the Secretary, 11, Hanover Square, London, W.

P. L. SCLATER, *Secretary*.

11, Hanover Square, August 1874.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE ACADEMY.

A Full Report of the Annual Meeting to be held at Belfast will appear in the *Academy* of August 22 and 29. Price 4*d.*; free by post, 4½*d.*

W. G. SMITH, 43, Wellington Street, Strand; and by order of all Booksellers and Newsmen.

CHEMICAL SOCIETY.

An INDEX to the JOURNAL of the CHEMICAL SOCIETY, 1841–1872, is now ready, including both Authors Names and Subjects. It may be obtained by Fellows at the Society's Rooms, price 5*s.*, by post 5*s* 4*d.*; and by Non-Fellows at the Publisher's, J. Van Voorst, 1, Paternoster Row, price 10*s.*

The JOURNAL of the CHEMICAL SOCIETY now contains Abstracts of all Papers on Chemistry, and its relations to Physiology and the Arts, published in British or Foreign Journals. It is issued monthly, and may be obtained by Non-Fellows of Mr Van Voorst by a subscription of £1 1*s.*

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences.

6*d.* MONTHLY, or POST-FREE, 6*s* 6*d.* PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—

The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions.
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

*** This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests, Subscription, 16*s.* 6*d.* per annum, post free, dating from any quarter-day, Single Copies, 1*s.* each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations, Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10*s.* each; the succeeding vols. may be had separately or together at 7*s.* each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B., F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s.* post free in the United Kingdom) payable in advance to the publishers, Messrs. Renken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16*s.* 6*d.* bound in cloth); also covers for the volume (price 1*s.*), and back numbers

MACMILLAN'S MAGAZINE.

No. 179. FOR SEPTEMBER.

PRICE 1s.

CONTENTS—

1.—"Woman Suffrage. A Reply." By J. E. Cairnes.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XIX.—XXI.
3.—"The Spectre of the Rose."
4.—"Who wrote our Old Plays?" By F. G. Fleay.
5.—"The Convent of St. Marco." III. "Preacher and Prior."
6.—"A Roman Funeral." By T. O.
7.—"The Future of Eastern Asia." By Sir Rutherford Alcock.
8.—"Agricultural Unionism." By A. J. Wilson.
9.—"The Sequence 'Dies Iræ.'" By A. Schwartz.
10.—"Prussia and the Vatican." I.

MACMILLAN & CO., London.

THE JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and Interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, S.W.

THE LINGUIST, AND *EDUCATIONAL REVIEW*:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,
Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

THE ZOOLOGIST:

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists;" those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

"*NATURE*."

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10s. 6d.

Cloth Cases for binding all the volumes, price 1s. 6d. each.

Reading Cases to hold 26 numbers, price 2s. 6d.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

Price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

NOW READY.

PRICE 1*s.*

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER OF PHYSIOLOGY.

BY

MICHAEL FOSTER, M.A., M.D., F.R.S.,

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

With Illustrations.

MACMILLAN & CO., LONDON.

A FEW ARTIST'S PROOFS

OF THE

PORTRAIT of PROF. TYNDALL, F.R.S., D.C.L., LL.D.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.,

PRICE 5*s.* EACH,

OR THROUGH ANY BOOKSELLER.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and FLESH-FORMING QUALITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading. Price 6*d.* per month, or 5*s.* per annum, post-free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOIL, by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

The BIRDS of SHETLAND, with Observations on their Habits, Migration, and Occasional Appearance. By the late HENRY L. SAXBY, M.D. Edited by his Brother, the Rev. STEPHEN H. SAXBY, of East Clevedon.

Edinburgh: MACLACHLAN & STEWART.

London: SIMPKIN, MARSHALL, & CO.

Just published, 8vo, pp. 334, 3*s.*

A PRACTICAL GUIDE to HEALTH, and to the Home-treatment of the COMMON AILMENTS OF LIFE; with a Section on SURGICAL EMERGENCIES, and HINTS to MOTHERS on Nursing, &c. By F. ARNOLD LEES, F.L.S. L.R.C.P. Lond., M.R.C.S. Eng.

London: KEMPSTER & CO., 9 and 10, St. Bride's Avenue, Fleet Street, E.C.

ZOOLOGICAL SOCIETY'S LATEST PUBLICATIONS.

"Proceedings of the Scientific Meetings of the Society for 1874."—Part II. containing the Papers read at the Scientific Meetings in March and April 1874. With 17 Plates, mostly coloured, 12*s.*; with Plates uncoloured, 3*s.*

NOTICE.

Commencing from January of the present year the "Proceedings" will be issued in four Parts, as follows:—

Part I., containing Papers read in January and February, on June 1st.
" II., " " March and April, on August 1st.
" III., " " May and June, on October 1st.
" IV., " " November and December, on April 1st.

The price will be 12*s.* per Part for the Edition with coloured, and 3*s.* per Part for that with uncoloured Plates.

These publications may be obtained at the Society's Office, 11, Hanover Square, W., at Messrs. LONGMANS, the Society's Publishers, Paternoster Row, E.C., or through any bookseller.

ELECTRIC CAMERAS,

MAGIC & PHANTASMAGORIA LANTERNS,

DISSOLVING VIEW APPARATUS,

With Oxycalcium, Oxyhydrogen, or Electric Light,

PHOTOGRAPHED AND COLOURED SLIDES,

Including Views of France, Italy, Switzerland, Rome, Pompeii; English, Welsh, and Scotch Scenery; Copies of Pictures, Drawings by Gustave Doré; Diagrams to illustrate recent Discoveries in Spectrum Analysis and other branches of Observational Astronomy.

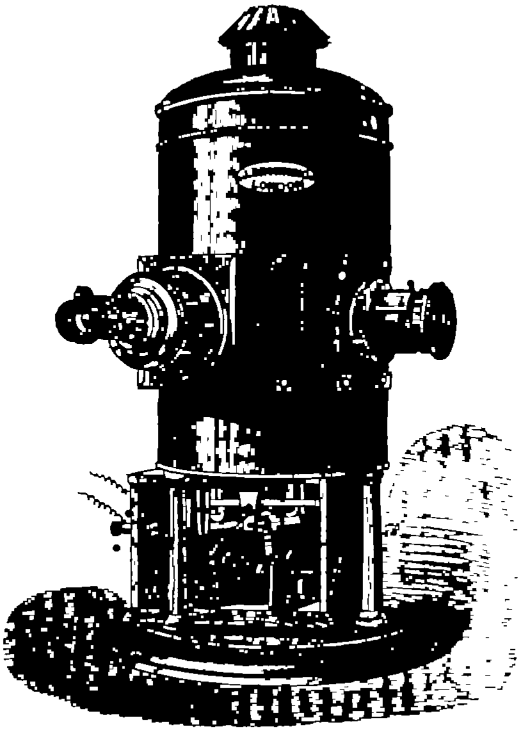
Statuary, Photo-Micrographs.

JOHN BROWNING,

Optical and Physical Instrument Maker

TO HER MAJESTY'S GOVERNMENT, THE ROYAL SOCIETY, THE ROYAL OBSERVATORY, &c. &c.

63, STRAND, W.C.,
AND
111, MINORIES, LONDON, E.



ESTABLISHED 100 YEARS.

Illustrated Lists, with Full Descriptions, on Application.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2*s.* 6*d.*; 9*d. per line after.*

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & Co.

OFFICE, BEDFORD STREET, STRAND, W.C.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen ...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3 ...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide ...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ...	£5	5	0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

PURE AERATED WATERS.

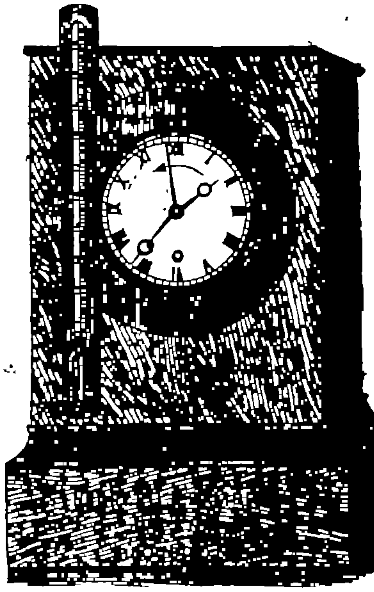
ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS.—W. BEST & SONS, Henrietta Street, Cavendish Square.



NEGRETTI & ZAMBRA'S

PATENT RECORDING THERMOMETER,

ADAPTED FOR ATMOSPHERIC AND DEEP-SEA TEMPERATURES.

THIS Thermometer differs from all other Registering or Recording Thermometers in the following important particulars :—

I.—The Thermometer contains only mercury, without any admixture of alcohol or other fluid.
II.—It has no indices or springs, and its indications are by the column of mercury.
III.—It can be carried in any position, and cannot possibly be put out of order, except by actual breakage of the instrument.

This new Recording Thermometer, in connection with a simple clock, will give the exact temperature of the air at any hour of the day or night, a most important addition to our Meteorological Instruments, especially to observers in many parts of the world who are engaged in taking simultaneous observations with our own at fixed Greenwich time.

The Thermometer arranged for deep-sea purposes will indicate and record the exact temperature, at any depth of the sea, irrespective of either warm or cold current or stratum through which the Thermometer may have to pass in its descent or ascent. This last qualification renders this Instrument vastly superior to the Thermometers now in use in the *Challenger* and other Deep-sea Expeditions ; for, *under certain conditions of temperature*, the old Thermometers on "Six's" principle have failed to give correct results. This we have on the authority of a Report to the Admiralty by Captain G. S. Nares, of H.M.S. *Challenger*, where, in speaking of temperature near the pack edge of the ice, he says :—

"*At a short distance from the pack the surface water rose to* 32°, *but at a depth of* 40 *fathoms we always found the temperature to be* 29° ; *this continued to* 300 *fathoms, the depth in which most of the icebergs float, after which there is a stratum of slightly warmer water of* 33° *or* 34°. *As the Thermometers had to pass through these two belts of water before reaching the bottom, the indices registered those temperatures, and it was impossible to obtain the exact temperature of the bottom whilst near the ice.*"

Illustrations and Prices of these Instruments upon application.

NEGRETTI & ZAMBRA,

OPTICIANS AND METEOROLOGICAL INSTRUMENT MAKERS TO HER MAJESTY, THE ROYAL OBSERVATORY, THE BRITISH AND FOREIGN GOVERNMENTS,

Holborn Viaduct, E.C. ; 122, Regent Street, W. ; and 45, Cornhill, London, E.C.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

BRYANT & MAY'S MATCHES.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided ; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

HOLLOWAY'S PILLS. — Indigestion,

Stomach and Liver Complaints.—Persons suffering from any disorders of the liver, stomach, or the organs of digestion, should have recourse to Holloway's Pills, as there is no medicine known that acts on these particular complaints with such certain success Its peculiar properties strengthen the stomach, increase the appetite, and rouse the sluggish liver. For bowel complaints it is invaluable, as it removes every primary derangement, thereby restoring the patient to the soundest health and strength. These preparations may be used at all times and in all climates by persons affected by biliousness, nausea, or disordered liver ; for flatulency and heartburn they are specifics. Indeed, no ailment of the digestive organs can long resist their purifying and corrective powers.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD.—Superseded by the above Imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c. gold appearance, which cannot be detected.

CASH PRICES

Watches, 25*s.* to 45*s.* Alberts, 2*s.* to 5*s.*; Long Chains, 5*s.* to 8*s.* 6*d.*; Lockets, 2*s.* to 5*s.* 6*d.*, Crosses, 1*s.* 6*d.* to 4*s.* 6*d.*, Ladies' Gem Rings, 2*s.* to 5*s.*; Wedding and Keeper Rings, 1*s.* to 2*s.* 6*d.*, Gents' Finger Rings, 2*s.* 6*d.* to 6*s.*; Bracelets, 5*s.* to 10*s.* 6*d.*: Studs, 1*s.* to 3*s.* 6*d.*; Links, 1*s.* to 3*s.*; Breast Pins, 1*s.* to 4*s.* 6*d.*; Brooches, 1*s.* 6*d.* to 7*s.* 6*d.*; Ear Rings, 1*s.* 6*d.* to 6*s.* 6*d.*: Sets (*en suite*), Brooch and Ear Rings, 5*s.* 6*d.* to 10*s.* 6*d.*, Pencil Cases, 2*s.* to 4*s.* 6*d.*, Gents' Snake Rings (Plain Head), 3*s.* 6*d.*, Head set with Brilliant, &c., 5*s.*

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years. Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "**MAZELINE**" GOLD **JEWELLERY** to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P.O.O. to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

NEW VOLUMES OF THE CLARENDON PRESS SERIES.

"Such Manuals, so admirable in matter, arrangement, and type, were never before given to the world at the same moderate price."—*Spectator.*

The WORKS of HORACE. Edited with Introductions, Essays, and English Notes. By E. C. WICKHAM, M.A., Head Master of Wellington College. Vol. I. Odes and Epodes. 8vo, 12*s.*

COWPER'S The TASK. With Tirocinium and Selections from the Minor Works. Edited, with Life and Notes, by H. T. GRIFFITH, M.A. Extra fcap. 8vo, 3*s.*

SELECT TITLES, from the DIGEST of JUSTINIAN. Edited by T. E. Holland, B.C.L. and C. L. SHADWELL, B.C.L. Part I. Introductory Titles. 8vo, 2*s.* 6*d.*

A CONSTITUTIONAL HISTORY of ENGLAND. Its Origin and Development. By W. STUBBS, M.A., Regius Professor of Modern History at Oxford. Vol. I. Crown 8vo, 12*s.*

GENEALOGICAL TABLES, Illustrative of MODERN HISTORY. By Hereford B. GEORGE, M.A. F.R.G.S. 4to, 12*s.*

Oxford: Printed at the "Clarendon Press," and Published by MACMILLAN & CO., London, Publishers to the University.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½*d.*, 1*s.* 1½*d.*, and 2*s.* 9*d.* Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2*s.* 9*d.* box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

⁂ The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation, and all the symptoms of Impending Consumption.

LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2*s.* 9*d.* by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

⁂ Order of any Chemist.

WORKS BY I. TODHUNTER, M.A., F.R.S.

"Perspicuous language, vigorous investigations, scrutiny of difficulties, and methodical treatment, characterise Mr. Todhunter's works."—*Civil Engineer.*

ALGEBRA. For the Use of Colleges and Schools. Sixth Edition. Crown 8vo, cloth. 7*s.* 6*d.*

This work contains all the propositions which are usually included in elementary treatises on Algebra, and a large number of Examples for Exercise. The author has sought to render the work easily intelligible to students, without impairing the accuracy of the demonstrations, or contracting the limits of the subject. The Examples, about sixteen hundred and fifty in number, have been selected with a view to illustrate every part of the subject. The work will be found peculiarly adapted to the wants of students who are without the aid of a teacher. The Answers to the Examples, with hints for the solution of some in which assistance may be needed, are given at the end of the book. In the present edition two New Chapters and Three Hundred miscellaneous Examples have been added.

KEY to ALGEBRA for the USE of COLLEGES and SCHOOLS. Crown 8vo., 10s. 6d.

An ELEMENTARY TREATISE on the THEORY of EQUATIONS. Second Edition, revised. Crown 8vo, cloth, 7*s.* 6*d.*

This treatise contains all the propositions which are usually included in elementary treatises on the theory of Equations, together with Examples for exercise. These have been selected from the College and University Examination Papers, and the results have been given when it appeared necessary. In order to exhibit a comprehensive view of the subject, the treatise includes investigations which are not found in all the preceding elementary treatises, and also some investigations which are not to be found in any of them. For the second edition the work has been revised and some additions have been made, the most important being in account of the Researches of Prof. Sylvester respecting Newton's Rule.

PLANE TRIGONOMETRY. For Schools and Colleges. Fourth Edition. Crown 8vo, cloth, 5*s.*

The design of this work has been to render the subject intelligible to beginners, and at the same time to afford the student the opportunity of obtaining all the information which he will require on this branch of Mathematics. Each chapter is followed by a set of Examples; those which are entitled Miscellaneous Examples, together with a few in some of the other sets, may be advantageously reserved by the student for exercise after he has made some progress in the subject. In the Second Edition the hints for the solution of the Examples have been considerably increased.

A TREATISE on SPHERICAL TRIGONOMETRY. Third Edition, enlarged. Crown 8vo, cloth, 4*s.* 6*d.*

The present work is constructed on the same plan as the treatise on Plane Trigonometry, to which it is intended as a sequel In the account of Napier's Rules of circular parts, an explanation has been given of a method of proof devised by Napier, which seems to have been overlooked by most modern writers on the subject. Considerable labour has been bestowed on the text in order to render it comprehensive and accurate, and the Examples (selected chiefly from College Examination Papers) have all been carefully verified.

PLANE CO-ORDINATE GEOMETRY, as applied to the Straight Line and the Conic Sections. With numerous Examples. Fourth Edition, revised and enlarged. Crown 8vo, cloth, 7*s.* 6*d.*

The author has here endeavoured to exhibit the subject in a simple manner for the benefit of beginners, and at the same time to include in one volume all that students usually require. In addition, therefore, to the propositions which have always appeared in such treatises, he has introduced the methods of abridged notation, which are of more recent origin; these methods, which are of a less elementary character than the rest of the work, are placed in separate chapters, and may be omitted by the student at first.

A TREATISE on the DIFFERENTIAL CALCULUS. With numerous Examples. Sixth Edition. Crown 8vo, cloth, 10*s.* 6*d.*

The author has endeavoured in the present work to exhibit a comprehensive view of the Differential Calculus on the method of limits. In the more elementary portions he has entered into considerable detail in the explanations, with the hope that a reader who is without the assistance of a tutor may be enabled to acquire a competent acquaintance with the subject. The method adopted is that of Differential Coefficients. To the different chapters are appended Examples sufficiently numerous to render another book unnecessary; these Examples being mostly selected from College Examination Papers. This and the following work have been translated into Italian by Prof. Battaglini.

A TREATISE on the INTEGRAL CALCULUS and its APPLICATIONS. With numerous Examples. Fourth Edition, revised and enlarged. Crown 8vo, cloth, 10*s.* 6*d.*

This is designed as a work at once elementary and complete, adapted for the use of beginners, and sufficient for the wants of advanced students. In the selection of the propositions, and in the mode of establishing them, it has been sought to exhibit the principles clearly, and to illustrate all their most important results. The process of summation has been repeatedly brought forward, with the view of securing the attention of the student to the notions which form the true foundation of the Calculus itself, as well as of its most valuable applications. Every attempt has been made to explain those difficulties which usually perplex beginners, especially with reference to the *limits* of integrations. A new method has been adopted in regard to the transformation of multiple integrals. The last chapter deals with the Calculus of Variations. A large collection of Exercises, selected from College Examination Papers, has been appended to the several chapters.

EXAMPLES of ANALYTICAL GEOMETRY of THREE DIMENSIONS. Third Edition, revised. Crown 8vo, cloth, 4*s.*

MACMILLAN & CO., LONDON.

Bragg's Vegetable Charcoal
Sold by all Chemists
in Bottles 2/4/& 6/ each

BRAGG'S VEGETABLE CHARCOAL,
OR
PURE CARBON BISCUITS.
A NUTRITIOUS, PLEASANT, AND HEALTHFUL DIET,

Which has produced great benefit and positive relief to thousands of sufferers from Indigestion, Bile, Acidity, Foul Breath, Dyspepsia, Heartburn, Worms, &c., at this season of the year; is now strongly recommended as a relief, if not a preventative, of Diarrhoea and other Choleraic Disorders. There is medical testimony to its beneficial effects in those complaints.

Sold in Tins, 1s., 2s., 4s., and 8s. each, by all Chemists, and by the Manufacturer,
J. L. BRAGG, 14 (late 2), Wigmore Street, Cavendish Square.

Now Ready. Price One Shilling.

ART
PICTORIAL AND INDUSTRIAL: A REVIEW.
FOR AUGUST 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.
"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF AUGUST NUMBER—Our Illustrations:—1. "Henry Fawcett, Esq., M.P., and Mrs. Fawcett," by Ford Madox-Brown. 2. "The Knight in Armour," by Wm. Cave Thomas. 3. "Lesson in Network," by J. F. Millet.—The Exhibitions: The Royal Academy, the Munich Gallery.—The Decoration of St. Paul's Cathedral, No. 2.—Art Notes and Gossip.—Reviews.

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,
London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,
Optician and Manufacturer of
ACHROMATIC MICROSCOPES,
and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,
As supplied to the principal Universities and Hospitals
Monocular, £5; Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from $\frac{1}{4}$ to $\frac{1}{16}$ inch, unequalled for their brilliant Defining and Penetrating Power

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14s.; 4½ in., 17s.; 6 in., in Wooden Case, 10s., including a Kew Certificate

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO
88, New Bond Street, W., London.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF PHYSICAL SCIENCE (Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

JUDSON'S DYES.—18 Colours, 6d. each.
RIBBONS, WOOL, SILK, FEATHERS,
Completely dyed in 10 minutes without soiling the hands.
Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

MACMILLAN & CO.'S

GOLDEN TREASURY SERIES.

Uniformly Printed in 18mo., with Vignette Titles by Sir NOEL PATON, T. WOOLNER, W. HOLMAN HUNT, J. E MILLAIS, ARTHUR HUGHES, &c. Engraved on Steel by JEENS. Bound in extra cloth, 4*s*. 6*d*. each volume. Also kept in morocco and calf bindings.

"*Messrs. Macmillan have, in their Golden Treasury Series, especially provided editions of standard works, volumes of selected poetry, and original compositions, which entitle this series to be called classical. Nothing can be better than the literary execution, nothing more elegant than the material workmanship.*"—British Quarterly Review.

The Golden Treasury of the Best Songs and Lyrical Poems in the English Language. Selected and arranged, with Notes, by FRANCIS TURNER PALGRAVE.

"*This delightful little volume, the Golden Treasury, which contains many of the best original lyric pieces and songs in our language, grouped with care and skill, so as to illustrate each other like the pictures in a well-arranged gallery.*"—Quarterly Review.

The Children's Garland from the best Poets. Selected and arranged by Coventry Patmore.

"*It includes specimens of all the great masters in the art of poetry, selected with the matured judgment of a man concentrated on obtaining insight into the feelings and tastes of childhood, and desirous to awaken its finest impulses, to cultivate its keenest sensibilities.*"—Morning Post.

The Book of Praise. From the best English Hymn Writers. Selected and arranged by Sir ROUNDELL PALMER. A New and Enlarged Edition.

The Fairy Book; the best Popular Fairy Stories. Selected and rendered anew by the Author of "John Halifax, Gentleman."

"*A delightful selection, in a delightful external form; full of the physical splendour and vast opulence of proper fairy tales.*"—Spectator.

The Ballad Book. A Selection of the Choicest British Ballads. Edited by William ALLINGHAM.

"*His taste as a judge of old poetry will be found, by all acquainted with the various readings of old English ballads, true enough to justify his undertaking so critical a task.*"—Saturday Review.

The Jest Book. The Choicest Anecdotes and Sayings. Selected and arranged by Mark LEMON.

"*The fullest and best jest book that has yet appeared.*"—Saturday Review.

Bacon's Essays and Colours of Good and Evil. With Notes and Glossarial Index. By W. ALDIS WRIGHT, M.A.

The Pilgrim's Progress from this World to that which is to come. By John Bunyan.

"*A beautiful and scholarly print.*"—Spectator.

The Sunday Book of Poetry for the Young. Selected and arranged by C. F. Alexander.

"*A well-selected volume of sacred poetry.*"—Spectator.

A Book of Golden Deeds of all Times and all Countries. Gathered and narrated anew. By the Author of "The Heir of Redclyffe."

The Poetical Works of Robert Burns. Edited, with Biographical Memoir, Notes, and Glossary, by Alexander Smith. Two vols.

The Adventures of Robinson Crusoe. Edited from the Original Edition by J. W. Clark, M.A., Fellow of Trinity College, Cambridge.

The Republic of Plato. Translated into English, with Notes by J. Ll. Davies, M.A., and D. J. VAUGHAN, M.A.

The Song Book. Words and Tunes from the best Poets and Musicians. Selected and arranged by John Hullah, Professor of Vocal Music in King's College, London.

La Lyre Francaise. Selected and arranged, with Notes, by Gustave Masson, French Master in Harrow School.

Tom Brown's School Days. By An Old Boy.

A Book of Worthies. Gathered from the Old Histories and written anew by the Author of "The Heir of Redclyffe."

MACMILLAN & CO., LONDON.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, August 27, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

NO. 253, VOL. 10] THURSDAY, SEPTEMBER 3, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office

[All Rights are Reserved

OWENS COLLEGE (MANCHESTER ROYAL) SCHOOL of MEDICINE.

Principal—J G GREENWOOD, LL D

Director of Medical Studies—GEORGE SOUTHAM, F R C.S.

PROFESSORS AND LECTURERS.

General Anatomy and Physiology ...	William Smith, F R C S
Practical Physiology and Histology ...	Arthur Gamgee, M D. F R S.
Descriptive and Practical Anatomy ...	Morrison Watson, M D. J Boswick Perrin, M R.C S.F L S,
Comparative Anatomy and Botany ...	W. C. Williamson, F R S.
Chemistry	Henry E. Roscoe, B A. Ph D. F.R S.
Medicine	William Roberts, M D. B A F.R C P John E Morgan, M.D. M A F R C P
Surgery	George Southam, F.R C S Edward Lund, F R C.S
Ophthalmology	Thomas Windsor, M R C S
Pathology and Morbid Anatomy	Henry Simpson, M D M R C S. Julius Dreschfeld, M D.
Midwifery and Diseases of Women and Children	John Thorburn, M D. L.R C S.
Materia Medica and Therapeutics ...	Alexander Somers. M R C S. Daniel John Leech, M.B.
Forensic Medicine	G. Morley Harrison, M R C S.
Hygiene and Public Health	Arthur Ransome, M D. M.A. M R C.S.
Clinical Medicine	The Physicians to the Royal Infirmary
Clinical Surgery	The Surgeons to the Royal Infirmary
Medical Tutor	J. Boswick Perrin, M R C S. F.L S.

The Winter Session will commence on the 1st October The new Medical School Buildings will be opened on the 2nd October by Professor T H. Huxley, F R.S A composition fee of £48 in one payment, or in two payments of £25 each, with an annual tutorial fee of £2 2s, admits to the complete Course of Study at the School, and a further sum of £42 to the Hospital Practice at the Royal Infirmary

Prospectuses will be forwarded on application.

J HOLME NICHOLSON, Registrar

Large post 8vo, cloth gilt, price 5s. 6d

BRITISH MARINE ALGÆ: being a Popular Account of the Seaweeds of Great Britain, their Collection and Preservation By W. H. GRATTANN. With 205 Illustrations.

Each little picture is a perfect gem of the engraver's art."—*Figaro*.

THE BAZAAR Office, 32, Wellington Street, London, W C

LONDON LIBRARY,

12, ST. JAMES'S SQUARE —Founded in 1841

Patron—H R H. THE PRINCE OF WALES.

President—THOMAS CARLYLE, ESQ

This Library contains 90,000 Volumes of Ancient and Modern Literature, in various Languages Subscription, £3 a year, or £2 with Entrance Fee of £6, Life Membership, £26.

Fifteen Volumes are allowed to Country, and Ten to Town Members. Reading Room open from Ten to half past Six. Prospectus on application. Catalogue, New Edition, in the press.

ROBERT HARRISON, Secretary and Librarian.

UNIVERSITY COLLEGE, LONDON, SCHOOL.

Head-Master—T HEWITT KEY, M A. F R S.

Vice-Master—E R. HORTON, M.A., Fellow of St. Peter's College, Cambridge

The SCHOOL will RE-OPEN for New Pupils on TUESDAY, September 22, at 9 30 a m The School Session is divided into three equal Terms, Fee, £8 per Term, to be paid at the beginning of each Term. Gymnastics Fencing, Drilling, and Advanced Drawing, extra

Extensive additional Buildings, including spacious Lecture-rooms for the Classes of Chemistry and Experimental Physics, have recently been completed for the use of the Pupils attending the School

A Playground of about two acres in extent, including several Fives' Courts, is attached to the School

Discipline is maintained without corporal punishment

A monthly report of the progress and conduct of each Pupil is sent to his parent or guardian.

The School is close to the Gower Street Station of the Metropolitan Railway, and only a few minutes' walk from the Termini of the North Western, Midland, and Great Northern Railways Season Tickets are granted at half-price to Pupils attending the School.

A Prospectus, containing full information respecting the Courses of Instruction given in the School, with other particulars, may be obtained at the Office of the College.

JOHN ROBSON, B.A.
August 1874. Secretary to the Council.

UNIVERSITY COLLEGE, LONDON.

The Professorship of Comparative Anatomy and Zoology is Vacant through the Death of Dr GRANT. Candidates for the Appointment are requested to send their Applications and Testimonials to the undersigned, from whom further Information may be obtained, on or before SATURDAY, October 31st.

JOHN ROBSON, B A
Secretary to the Council

ROYAL SCHOOL OF MINES.

DEPARTMENT OF SCIENCE AND ART.

During the Twenty fourth Session, 1874–75, which will commence on the 1st of October, the following COURSES of LECTURES and PRACTICAL DEMONSTRATIONS will be given:—

1. Chemistry By E Frankland, Ph D F R.S.
2. Metallurgy. By John Percy, M D F R S
3. Natural History. By T. H Huxley, LL.D. F.R.S
4. Mineralogy. } By Warington W. Smith, M A. F.R S,
5. Mining. } *Chairman*
6. Geology By A. C Ramsay, LL.D. F R S.
7. Applied Mechanics By T M Goodeve, M.A.
8. Physics By Frederick Guthrie, Ph D F R.S.
9. Mechanical Drawing. By Rev. J. H. Edgar, M.A.

The Fee for Students desirous of becoming Associates is £30 in one sum, on entrance, or two annual payments of £20, exclusive of the Laboratories

Tickets to separate Courses of Lectures are issued at £3 and £4 each.

Officers in the Queen's Service, Her Majesty's Consuls, Acting Mining Agents, and Managers, may obtain Tickets at reduced prices.

Science Teachers are also admitted to the Lectures at reduced fees.

For a Prospectus and information apply to the Registrar, Royal School of Mines, Jermyn Street, London, S.W.

TRENHAM REEKS, Registrar.

NOTE —By order of the Lords of the Committee of Council on Education, the instruction in Chemistry, Physics, Applied Mechanics, and Natural History will be given in the New Buildings in the Exhibition Road, South Kensington

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

Opening of WINTER SESSION, October 1st, 1874. Introductory Address by Mr. EDMUND OWEN

For further particulars apply to the Registrar at the Hospital, or to

A. B. SHEPHERD, M B, Dean of the School.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

THREE OPEN SCHOLARSHIPS and TWO EXHIBITIONS, October 1874.

For particulars apply to the Dean, St. Mary's Hospital, Paddington, W.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

SCHOLARSHIPS IN SCIENCE.

Two Scholarships in Science have been founded at St Bartholomew's Hospital:—

1. An Open Scholarship of the value of £100, tenable for one year, to be competed for in September The subjects of examination are Physics, Chemistry, Botany, and Zoology. The successful candidate will be required to enter at St. Bartholomew's Hospital in October next.

2. Preliminary Scientific Scholarship of the value of £50, tenable for one year, to be competed for in October next by Students of the Hospital of less than six months' standing The subjects of examination are identical with those of the Open Scholarship.

For further particulars and syllabus of subjects, application may be made personally or by letter to the Warden of the College, St. Bartholomew's Hospital.

WESTMINSTER HOSPITAL MEDICAL SCHOOL.

(OPPOSITE WESTMINSTER ABBEY)

The SESSION 1874-75 will commence on THURSDAY, October 1st, with an INTRODUCTORY LECTURE by Dr POTTER The Address will be followed by the Distribution of the Prizes and a Conversazione in the Board Room.

The new Physiological Laboratory will be completed by October 1st.

The Examinations for the Entrance Scholarships will be held on the 2nd and 3rd of October.

GEORGE COWELL, Dean

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F R S.; Dr. Williamson, F.R.S

The Term commences TUESDAY, September 15.

C. WILLMORE, Principal.

THE VICTORIA (PHILOSOPHICAL) INSTITUTE.

Amongst the newly enrolled Members of this Society is M JOACHIM BARRAUDE, of Bohemia, known for his Palæontological Works The Society has just issued the full Report of the Discussion on FLINT IMPLEMENTS held at the Society of Arts, in which Mr Evans, F.R S. Dr. Carpenter, F.R.S, Professor Tennant, and others, took part.

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W

MATRICULATION EXAMINATION, LOND. UNIV, January 1875.

F. A. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, READS WITH PUPILS for this Exam. He is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Exam, having passed fifty-seven Pupils, to whom reference can be given. Two of these passed in the Honours list in January 1873, seventh and fourteenth respectively A Class will commence early in September, and another early in October. Fees for the two, £14 and £10 10s respectively. For further particulars, address 24, Old Square, Lincoln's Inn, W C—A few Residents can be accommodated in Mr. Hanbury's house at Clapham.

PRELIMINARY EXAMINATION IN ARTS, ROYAL COLL SURG, December 1874.

F. A. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, PREPARES PUPILS for this Exam He is assisted by efficient Lecturers in French and Chemistry, and has passed several Pupils for this Exam, to whom reference can be given Terms from 8 to 12 Guineas, according to subjects taken up and time of joining the class. For further particulars, address 24, Old Square, Lincoln's Inn, W.C.

A LADY, thoroughly experienced, her tastes

literary, desires a RE-ENGAGEMENT as COMPANION or AMANUENSIS Possesses knowledge of Housekeeping No objection to travel. Excellent references—M.B, 13, Bishopsgate Street Without, E C.

The SECOND MASTER of a High-class

Grammar School receives a few Resident Pupils Special attention is given to the study of Natural Sciences—For further particulars apply by letter to "Tripos," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

MATHEMATICS and SCIENCE.—Pupils

prepared for Competitive and Pass Examinations by a High Wrangler and Nat. Science Man Successful in Tuition. In the Country by Correspondence. Classes visited—J. F. BLAKE, 6, Wells Road, Regent's Park, N W.

MINERALS and ROCKS, Classified after

Miller, Dana, and Rose. 100 Examples, 25s; 200 ditto, £2 10s to £3 10s., 300 ditto, £4 10s. to £6, 400 ditto, £6 to £8, 500 ditto, £8 8s to £10 10s. Including Half Fossils, 250 Examples £3 10s. 6d.; 400 ditto, £6 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s, 250 ditto (most of the species figured), £3, 350 ditto, £5 to £6 RECENT SHELLS: 100 genera, £1; 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

E. DENT & CO., 61, Strand, & 34, Royal Exchange
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c., of J TENNANT, Mineralogist to Her Majesty, 149, Strand, London

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F R G S, at his residence, 149, Strand, W C

TO NATURALISTS and GEOLOGISTS.—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS (See Advertisement in NATURE of June 18th) For particulars of these Collections address Fredc. Collingwood, Esq., F G S, 4, St Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."
July 8th.

FOR SALE.—A Collection of Rare Moths, &c, the property of a Missionary in India.—Apply at the Baptist Mission House, 19, Castle Street, Holborn, E C

FOR SALE.—A 5-inch REFLECTING TELESCOPE, by Dolland, with heavy brass stand; has two eye-pieces with sun glasses, handles for right ascension and declination motions. The whole packed in a substantial Mahogany Box For further particulars and price apply to G STEPHENS, New Street, Basingstoke.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application Orders exceeding £2 in value delivered free to any railway station in England.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using 10s. 6d, sent for P O order—ALEX ROSS, 248, High Holborn, London, and all Chemists

---

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain Price 10s 6d, sent carriage-free for P.O order—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps

---

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s; Ladies' Chest Expanders from 5s. 6d. SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM, 1. Dissentient. 2. Demonstrative. 3. Speculative. 16 Plates, 10s 6d Now ready, Third Edition.
J. & A. CHURCHILL.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d.
J. & A. CHURCHILL
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition, 28 Plates, 12s 6d.
J & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS. Third Edition, 25s.
J. & A CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s 6d.
J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition, much enlarged. [In the Press.
J. & A CHURCHILL.
7. HOW to WORK with the MICROSCOPE. 21s.
HARRISON, Pall Mall.

KIRKES' PHYSIOLOGY.

Eighth Edition, with 250 Illustrations, post 8vo, 12s 6d.

HANDBOOK of PHYSIOLOGY. By WILLIAM SENHOUSE KIRKES, M D. Eight Edition. Revised and Edited by W. MORRANT BAKER, F R C S, Lecturer on Physiology and Assistant-Surgeon to the St Bartholomew's Hospital, and Surgeon to the Evelina Hospital for Sick Children.

JOHN MURRAY, Albemarle Street.

Just published, 8vo, pp 334, 3s.

A PRACTICAL GUIDE to HEALTH, and to the Home-treatment of the COMMON AILMENTS OF LIFE; with a Section on SURGICAL EMERGENCIES, and HINTS to MOTHERS on Nursing, &c By F. ARNOLD LEES, F.L.S L.R.C.P. Lond, M R C S Eng

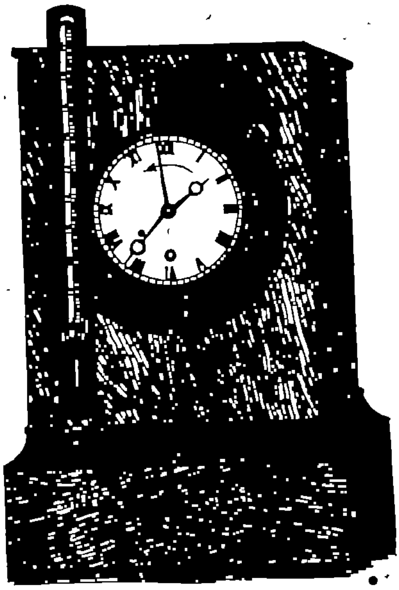
London: KEMPSTER & CO, 9 and 10, St. Bride's Avenue, Fleet Street E C

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS, BREWERS, STOCKWELL.

HOLLOWAY'S PILLS and OINTMENT.—DELICATE HEALTH—In debility, languor, and nervousness, generated by excess of any kind, whether mental or physical, the effect of these pills is in the highest degree bracing, renovating, and restorative. They drive from the system the morbid cause of disease, whether its origin be evident or its situation undiscoverable, they re-establish the digestion, regulate all the secretions, quiet the nervous system, raise the patients' spirits, and bring back the frame to its pristine health and vigour. Holloway's pills increase the appetite, while they secure perfect digestion to all ordinary food, and release the invalid from restraint in diet. In a word, whatever the cause of decline, the pills place the patient in the position most favourable to recovery



NEGRETTI & ZAMBRA'S

PATENT RECORDING THERMOMETER,

ADAPTED FOR ATMOSPHERIC AND DEEP-SEA TEMPERATURES.

THIS Thermometer differs from all other Registering or Recording Thermometers in the following important particulars :—

I.—The Thermometer contains only mercury, without any admixture of alcohol or other fluid.

II.—It has no indices or springs, and its indications are by the column of mercury.

III.—It can be carried in any position, and cannot possibly be put out of order, except by actual breakage of the instrument.

This new Recording Thermometer, in connection with a simple clock, will give the exact temperature of the air at any hour of the day or night, a most important addition to our Meteorological Instruments, especially to observers in many parts of the world who are engaged in taking simultaneous observations with our own at fixed Greenwich time.

The Thermometer arranged or deep-sea purposes will indicate and record the exact temperature, at any depth of the sea, irrespective of either warm or cold current or stratum through which the Thermometer may have to pass in its descent or ascent. This last qualification renders this Instrument vastly superior to the Thermometers now in use in the *Challenger* and other Deep-sea Expeditions ; for, *under certain conditions of temperature*, the old Thermometers on "Six's" principle have failed to give correct results. This we have on the authority of a Report to the Admiralty by Captain G. S. Nares, of H.M.S. *Challenger*, where, in speaking of temperature near the pack edge of the ice, he says :—

"At a short distance from the pack the surface water rose to 32°, but at a depth of 40 fathoms we always found the temperature to be 29° ; this continued to 300 fathoms, the depth in which most of the icebergs float, after which there is a stratum of slightly warmer water of 33° or 34°. As the Thermometers had to pass through these two belts of water before reaching the bottom, the indices registered those temperatures, and it was impossible to obtain the exact temperature of the bottom whilst near the ice."

Illustrations and Prices of these Instruments upon application.

NEGRETTI & ZAMBRA,

OPTICIANS AND METEOROLOGICAL INSTRUMENT MAKERS TO HER MAJESTY, THE ROYAL OBSERVATORY, THE BRITISH AND FOREIGN GOVERNMENTS,

Holborn Viaduct, E.C. ; 122, Regent Street, W. ; and 45, Cornhill, London, E.C.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever And superior to all others *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867 Also Testimonials from Dr Hassall, September 23, 1869 ; Dr Lankester, September 10, 1867, Dr. Letheby, February 15, 1865, and December 1872.

Price £1 10s. and upwards Portable Filters on this system, £1 5s to £3

Patronised and used by Her Majesty the Queen, at Osborne ; by H R H. the Prince of Wales, at Sandringham, by H.R H the Duke of Cambridge ; the *élite* of the Medical Profession, and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d and 21s each

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one —*Vide* DYKE on the Preliminary Duties of Health Officers

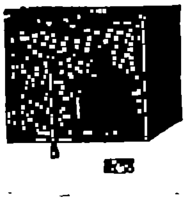
Pocket Filters from 4s. 6d to 6s each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary at the Office,

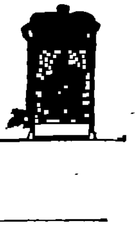
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water : its Impurities and Purification," price, per post, 2d

House Cistern, fitted with a Cistern Filter.



Portable Cistern Filter.



W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

THOMAS D. RUSSELL,

GEOLOGIST & MICROSCOPIST,

48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens — — — One Guinea.
British Fossils—100 — — — One Guinea.

Collections and Specimens of British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

Bragg's Vegetable Charcoal
Sold by all Chemists
in Bottles 2/- 4/- & 6/- each

BRAGG'S VEGETABLE CHARCOAL,
OR
PURE CARBON BISCUITS.

A NUTRITIOUS, PLEASANT, AND HEALTHFUL DIET,

Which has produced great benefit and positive relief to thousands of sufferers from Indigestion, Bile, Acidity, Foul Breath, Dyspepsia, Heartburn, Worms, &c, at this season of the year, is now strongly recommended as a relief, if not a preventative, of Diarrhœa and other Choleraic Disorders There is medical testimony to its beneficial effects in those complaints.

Sold in Tins, 1s., 2s, 4s., and 8s each, by all Chemists, and by the Manufacturer,

J. L. BRAGG, 14 (late 2), Wigmore Street, Cavendish Square.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—

JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper

Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses,

Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A

Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.

—Much trouble may be saved in grinding up colours to a uniform tint They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—

Diluted with Water. They sink deeply into the fibre, and will not rub off They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country

---

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland

It writes almost instantly Full Black.
Does not corrode Steel Pens
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M B, F L S, British Museum, assisted by J G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs Ranken and Co., Drury House, St Mary-le-Strand, London, W C., of whom may be obtained the volume for 1873 (price 16s. 6d. bound in cloth): also covers for the volume (price 1s.), and back numbers

---

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences

6d. MONTHLY, or POST-FREE, 6s 6d PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—

The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers
Descriptive Accounts of useful Patents and Inventions
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

⁂ This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

Now ready, 8vo, 10s 6d.

CLINICAL MEDICINE,

Lectures and Essays.

By BALTHAZAR FOSTER, M D. F R C P,

Professor of Medicine in Queen's College, Physician to the General Hospital, Birmingham.

"The book may be taken up with advantage and profit, read with confidence as to its genuineness, and laid down with a feeling of admiration of the author's appreciation of clinic l facts, and his facile and reasonable method of putting them"—*British Medical Journal.*

J. & A. CHURCHILL, New Burlington Street.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters

REVIEW OF THE MALT AND HOP TRADES, AND WINE AND SPIRIT TRADES RECORD

The Official Organ of the Country Brewers' Society. (Founded 1822)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests, Subscription, 16s. 6d per annum, post free, dating from any quarter-day Single Copies, 1s. each Registered for transmission abroad

Offices—5, Bond Court, Walbrook, London, E C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations, Conducted by J W. DOUGLAS, R McLACHLAN, F L.S., E. C. RYE, and H. T STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year

Vols I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each, the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N B.—Communications, &c., should be sent to the Editors at the above address.

DIARY OF SOCIETIES.

LEEDS

MONDAY, SEPTEMBER 7

GEOLOGICAL ASSOCIATION, at 8.—On the Construction of Geological Maps: L. C. Miall.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

THE ZOOLOGIST:

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists;" those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s*. 6*d*.

Cloth Cases for binding all the volumes, price 1*s*. 6*d*. each.

Reading Cases to hold 26 numbers, price 2*s*. 6*d*.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

EVERY THURSDAY, PRICE 4*d*.

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 o'clock on Wednesdays.

Post-office Orders payable to MACMILLAN & Co.

OFFICE, BEDFORD STREET, STRAND, W.C.

CLARENDON PRESS PUBLICATIONS.

A TREATISE ON ELECTRICITY AND MAGNETISM.

By J. CLERK MAXWELL, M.A. F.R.S., Professor of Experimental Physics in the University of Cambridge. 2 vols. 8vo, £1 11*s*. 6*d*.

The GEOLOGY of the VALLEY of the THAMES.

By JOHN PHILLIPS, M.A. F.R.S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo, 21*s*.

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum.*

VESUVIUS. By John Phillips, M.A., F.R.S.

With numerous Maps and Illustrations. Crown 8vo, 10*s*. 6*d*.

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction. His plan has been successfully carried out, and has resulted in a work of high value."—*Pall Mall Gazette.*

DESCRIPTIVE ASTRONOMY. A Handbook for the General Reader, and also for practical Observatory work.

With 224 Illustrations and numerous Tables. By G. F. CHAMBERS, F.R.A.S., Barrister-at-Law. Demy 8vo, cloth, 856 pp., price 21*s*.

CHEMISTRY FOR STUDENTS.

By A. W. WILLIAMSON, Phil. Doc. F.R.S., Professor of Chemistry, University College, London. New Edition, with Solutions. Extra fcap 8vo, cloth, price 8*s*. 6*d*.

EXERCISES IN PRACTICAL CHEMISTRY.

By A. G. VERNON HARCOURT, M.A. F.R.S., Senior Student of Christ Church, and Lee's Reader in Chemistry, and H. G. MADAN, M.A., Fellow of Queen's College, Oxford. Series I, Qualitative Exercises. Second Edition. Crown 8vo, price 7*s*. 6*d*.

AN ELEMENTARY TREATISE ON HEAT.

By BALFOUR STEWART, LL.D. F.R.S., Professor of Natural History in Owens College, Manchester. Ext. fcap 8vo, with numerous Woodcuts and Diagrams, 7*s*. 6*d*. New Edition, revised and enlarged.

"The publication of this manual is exceedingly well-timed, it includes within narrow limits the leading facts and principles of this younger-born of the Sciences, and for the mastery of the greater portion of the contents only requires ordinary intelligence on the part of the reader."—*Spectator.*

FORMS OF ANIMAL LIFE. Being Outlines of Zoological Classification based upon Anatomical Investigation, and illustrated by Descriptions and Specimens and of Figures.

By G. ROLLESTON, M.D. F.R.S., Linacre Professor of Physiology, Oxford. Demy 8vo, price 16*s*.

A TREATISE on ACOUSTICS.

By W. J. DONKIN, F.R.S., Savilian Professor of Astronomy in the University of Oxford. Crown 8vo, price 7*s*. 6*d*.

A SYSTEM OF PHYSICAL EDUCATION: Theoretical and Practical.

With 346 Illustrations drawn by A. MACDONALD, of the Oxford School of Art. By ARCHIBALD MACLAREN, The Gymnasium, Oxford. Ext. fcap. 8vo, price 7*s*. 6*d*.

"The work before us is one which should be in the hands of every schoolmaster and schoolmistress. It is marked in every line by good sense, and is so clearly written that no one can mistake its rules."—*Lancet.*

ELEMENTS OF NATURAL PHILOSOPHY.

By Sir W. THOMSON, LL.D. D.C.L. F.R.S., Professor of Natural Philosophy, Glasgow, and P. G. TAIT, M.A., Professor of Natural Philosophy, Edinburgh. Part I, 8vo, 9*s*.

Oxford: Printed at the Clarendon Press, and Published by MACMILLAN & CO., London, Publishers to the University.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c. gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s. to 45s.; Alberts, 2s. to 5s.; Long Chains, 5s. to 8s. 6d.; Lockets, 2s. to 5s. 6d.; Crosses, 1s. 6d. to 4s. 6d.; Ladies' Gem Rings, 2s. to 5s.; Wedding and Keeper Rings, 1s. to 2s. 6d.; Gents' Finger Rings 2s. 6d. to 6s.; Bracelets, 5s. to 10s. 6d.; Studs, 1s. to 3s. 6d.; Links, 1s. to 3s.; Breast Pins, 1s. to 4s. 6d.; Brooches, 1s. 6d. to 7s. 6d.; Ear Rings, 1s. 6d. to 6s. 6d.; Sets (*en suite*), Brooch and Ear Rings, 5s. 6d. to 10s. 6d.; Pencil Cases, 2s. to 4s. 6d.; Gents' Snake Rings (Plain Head), 3s. 6d.; Head set with Brilliant, &c., 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years. Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "**MAZELINE**" GOLD JEWELLERY to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P.O.O. to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½d., 1s. 1½d., and 2s. 9d. Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2s. 9d. box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

*** The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation, and all the symptoms of Impending Consumption.

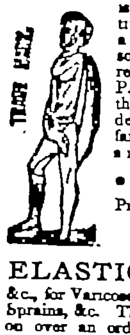
LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2s. 9d. by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

*** Order of any Chemist.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS



is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

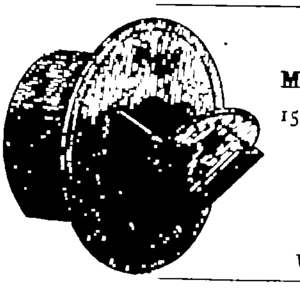
JOHN WHITE, Manufacturer, 228, Piccadilly, London.

FOR MICROSCOPE DRAWING

THE

NEUTRAL TINT CAMERA

Is the easiest and best, and can be fitted to any Microscope Eye-piece by sending Cap for size per post. Price 7s. 6d. Post Orders payable at Great Portland Street.

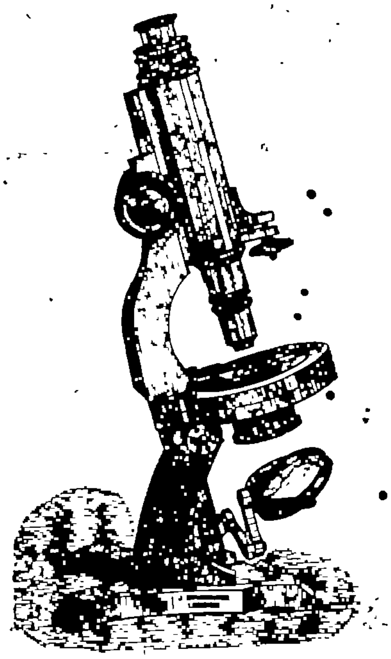


CHAS. COLLINS,
Maker to the Government,
157, GREAT PORTLAND ST.,
LONDON, W.

SOLE MAKER OF THE
"HARLEY"
BINOCULAR MICROSCOPE.

ILLUSTRATED CATALOGUE OF MICROSCOPES and all Apparatus free per post on application.

BROWNING'S NEW ROTATING BODY MICROSCOPE.



This Instrument has a simple yet perfectly concentric turning stage, the stage and the eyepiece revolving together on the same axis; thus the image remains in the field of view during the whole revolution, whatever objective be used.

Price of the Microscope complete, with two Object-glasses, 1 in. of 16° angular aperture, and ¼ in. 75°, two Eyepieces, A and B, Hand Pliers and Stage Plate £10 10 0

The MODEL MICROSCOPE, with highly-finished Brass Band, Rack and fine Adjustments to body, with Axis for inclination, one Eyepiece, Concave Mirror, and 1-inch Objective and ¼-in. Object-glasses £5 5 0

List of Microscopes free.

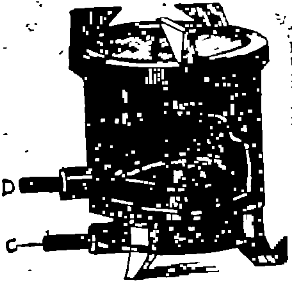
JOHN BROWNING,
Optical and Physical Instrument Maker to the Royal Observatory, &c.
63, STRAND, W.C.,
AND
111, MINORIES, LONDON, E.

ESTABLISHED 100 YEARS.

An Illustrated Descriptive Catalogue of Spectroscopes, 18 Stamps.

1871.—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873.—INTERNATIONAL EXHIBITION, PRIZE MEDAL.

FLETCHER'S
NEW LOW TEMPERATURE BURNER (PATENT)



This Burner gives a range of heating power from a gentle current of WARM air to a BRIGHT RED HEAT, and is so perfectly under control that a common glass bottle may be placed on the tripod without protection and heated to any required temperature without the slightest risk of fracture. In practical use it dispenses with the necessity for drying-closets, sand-and-water baths, &c.

For very low temperatures the ring must be lighted through the opening B; this causes a current of warm air to rise through the gauze above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube.

Price, without blast tube — — — — — 7s. 6d.
" with blast tube for high temperatures — 9s. 0d.

UNIVERSAL FURNACE (GAS),

For High Temperatures (without blast) for Crucibles, Muffles, &c, in several sizes and patterns. Special designs made to order.

NEW BUNSEN BURNERS, giving a range of temperature up to a clear white heat, 10s 6d.

HOT BLAST BLOWPIPES, giving temperatures exceeding the fusing-point of platinum, 11s 6d, 13s., 15s.

POWERFUL FOOT-BLOWERS, 18s.

Drawings and description from dealers in Chemical Apparatus, or from

THOMAS FLETCHER, F.C.S.,
13 & 15, SUEZ STREET,
WARRINGTON.

TISLEY'S
PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on — — — — — — — — — —	£12 0 0
Reflectors for projecting the Figures on the Screen — —	2 12 6
N:B.—Specimen Curves, on card, post free — per dozen —	0 3 0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3 —	0 7 6
Ditto traced on blackened Glass, for the Lantern — per slide —	0 3 6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution — £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South-Kensington Museum).

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

Printed by R. Clay, Sons, & Taylor, at 7 and 8, Bread Street Hill, in the City of London, and published by Macmillan & Co. at the Office, 29 and 30, Bedford Street, Covent Garden.—Thursday, September 3, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 254, Vol. 10] THURSDAY, SEPTEMBER 10, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office

[All Rights are Reserved

THE MIDDLESEX HOSPITAL COLLEGE.

The WINTER SESSION, 1874-5, will open on OCTOBER 1st, with an INTRODUCTORY ADDRESS at 3 o'clock, by Mr. ANDREW CLARK, F.R.C.S

The Medical College attached to the Hospital provides the most complete means for the education of Students

The College Tutors superintend and assist all general students in their studies, especially those who are preparing for Examinations, without extra fee, and thus the necessity for obtaining private instruction is obviated

General Fee for the Curriculum required by the Royal Colleges of Physicians and Surgeons, and the Society of Apothecaries, £90, which may be paid by instalments.

For full particulars as to Entrance and other Scholarships, Clinical Appointments, Residence of Students, &c , apply to the Dean.

ROBERT KING, B.A. M.B , Dean.

UNIVERSITY OF LONDON.

MATRICULATION AND PRELIMINARY SCIENTIFIC EXAMINATIONS.

Special Classes for these Examinations are held at St. Bartholomew's Hospital. The Classes are not confined to Students of the Hospital

A Class for the Matriculation Examination is held twice in each year, from October to January, and from March to June.

A Class for the Preliminary Scientific Examination is held from January to July

For particulars, application may be made, personally or by letter, to the Warden of the College, St Bartholomew's Hospital.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus, F.R.S ; Dr Frankland, F.R S. ; Dr. Roscoe, F.R S. ; Dr Angus Smith, F.R S ; Dr. Tyndall, F.R S. ; Dr Voelcker, F R S. , Dr. Williamson, F R S.

The Term commences TUESDAY, September 15.

C. WILLMORE, Principal.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

The WINTER SESSION will begin on THURSDAY, October 1

The Clinical Practice of the Hospital comprises a service of 740 Beds, inclusive of 34 Beds for Convalescents at Highgate.

Students can reside within the Hospital walls, subject to the College regulations.

For all particulars concerning either the Hospital or College, application may be made, personally or by letter, to the Resident Warden of the College

A Handbook will be forwarded on application

LECTURE ON THE SUN,

By Mr. RICHARD DART,

ILLUSTRATED BY

Models, Diagrams, and Chemical Experiments.

SYLLABUS.

Introduction—The Nature of Fire—Spectrum Analysis—The Spectroscope—The Practical Application of the Spectroscope—Its Application to the Sun—Evidence afforded by Spectrum Analysis that the Sun is Fire—The Sun's Spots—Selective Absorption—The Sun's Motion—Spherical Form—Magnitude—Conclusion.

Terms: London, Three Guineas, Country, Five Guineas

Address:—12, BEDFORD STREET, STRAND, LONDON.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

Opening of WINTER SESSION, October 1st, 1874. Introductory Address by Mr EDMUND OWEN

For further particulars apply to the Registrar at the Hospital, or to

A. B SHEPHERD, M B , Dean of the School

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

THREE OPEN SCHOLARSHIPS and TWO EXHIBITIONS, October 1874.

For particulars apply to the Dean, St. Mary's Hospital, Paddington, W.

NOTICE.—ROYAL SCHOOL of MINES,

Jermyn Street, London.—The 24th SESSION will begin on THURSDAY, the 1st October

Prospectuses may be had on application

TRENHAM REEKS, Registrar.

EVENING SCIENCE LECTURES.—Mr.

W J W. WILSON, F.C S. F P S (Demonstrator of Practical Physics at South Kensington), will commence the following Courses of Lectures in the Theatre of the Birkbeck Institution, Southampton Buildings, W.C , on October 1st and 2nd .—

Acoustics, Light, and Heat, 30 Lectures, on Thursdays, at 8 p m
Electricity and Magnetism, 30 Lectures, on Fridays, at 8 p m.

Fee for one Course, 5s ; for the two, 7s 6d For detailed Syllabus, particulars of Special Prizes, &c , apply to the Librarian.

At the Class Examinations of the Science and Art Department, May 1874, 130 Papers in Physics were worked by Mr Wilson's Pupils Of these, 87 passed First Class and obtained Queen's Prizes , 41 passed Second Class , and two failed. In 1873, 68 Papers worked . 45 First Class, 23 Second Class, and *none failed*

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate Analyses and investigations conducted.—Apply to Prof E. V. GARDNER, F R.S., F.S.A., 44, Berners Street, W

EVENING SCIENCE LECTURES.—PHYSICAL GEOGRAPHY AND GEOLOGY.—Mr. H FISHER, F G.S, will deliver, at the Birkbeck Institution, Southampton Buildings, Chancery Lane, a Course of Thirty Lectures on each of the above subjects, on THURSDAY EVENINGS at 7 and 8 o'clock respectively, commencing October 1st. Fee for the Two Courses, 7s. 6d.; a Single Course, 5s —For further particulars apply to Secretary.

A BARGAIN.—For Sale, a Solid TELESCOPIC SPECULUM. Never used. Cost £31. No reasonable offer refused.—Apply to J. DREW APPLEBY, 10, Park Road, Newcastle-on-Tyne.

PRELIMINARY EXAMINATIONS of the COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr. J. ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations. For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c., address to 3, Pump Court, Temple, or to the care of Messrs. Butterworth, 7, Fleet Street, her Majesty's Publishers.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 25s., 200 ditto, £2 10s to £3 10s.; 300 ditto, £4 10s. to £6, 400 ditto, £6 to £8, 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples, £3 10s. 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s: 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6 RECENT SHELLS: 100 genera, £1; 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

TO NATURALISTS and GEOLOGISTS.—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS (See Advertisement in NATURE of June 18th) For particulars of these Collections address Fredc. Collingwood, Esq, F.G S., 4, St Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND."

July 8th.

A LADY, thoroughly experienced, her tastes literary, desires a RE-ENGAGEMENT as COMPANION or AMANUENSIS Possesses knowledge of Housekeeping. No objection to travel. Excellent references.—M.B., 13, Bishopsgate Street Without, E.C.

The SECOND MASTER of a High-class Grammar School receives a few Resident Pupils Special attention is given to the study of Natural Sciences.—For further particulars apply by letter to "Tripos," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO, LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

GEOLOGY.—ELEMENTARY COLLECTIONS to Illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells Geological Maps, Hammers, all the Recent Publications, &c, of J TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R G.S., at his residence, 149, Strand, W C.

MATRICULATION EXAMINATION, LOND. UNIV., January 1875.

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, READS WITH PUPILS for this Exam. He is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Exam, having passed fifty-seven Pupils, to whom reference can be given. Two of these passed in the Honours list in January 1873, seventh and fourteenth respectively. A Class will commence early in September, and another early in October. Fees for the two, £14 and £10 10s. respectively. For further particulars, address 24, Old Square, Lincoln's Inn, W.C—A few Residents can be accommodated in Mr. Hanbury's house at Clapham.

PRELIMINARY EXAMINATION IN ARTS, ROYAL COLL. SURG., December 1874.

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, PREPARES PUPILS for this Exam He is assisted by efficient Lecturers in French and Chemistry, and has passed several Pupils for this Exam, to whom reference can be given. Terms from 8 to 12 Guineas, according to subjects taken up and time of joining the class. For further particulars, address 24, Old Square, Lincoln's Inn, W.C.

MATHEMATICS and SCIENCE.—Pupils prepared for Competitive and Pass Examinations by a High Wrangler and Nat. Science Man Successful in Tuition In the Country by Correspondence. Classes visited.—J. F. BLAKE, 6, Wells Road, Regent's Park, N.W.

FOR SALE.—A Collection of Rare Moths, &c., the property of a Missionary in India —Apply at the Baptist Mission House, 19, Castle Street, Holborn, E.C.

The Half-Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO, by appointment to the Army and Navy, 29a, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO, 29a, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 29a, Strand, London.

HOLLOWAY'S PILLS.—Hale Constitutions —The experience of years has shown that when the human frame has become debilitated from the effects of exposure, excess, or neglect, these Pills taken according to the directions will repair the mischief. Holloway's Pills exercise the most wonderful tonic properties in all cases of nervous depression, whereby the vital powers are weakened, and the circulation is languid and unsteady. They improve the appetite, strengthen the digestion, regulate the liver, and act as gentle aperients The Pills are suited to all ages and habits. A patient writes: "Your Pills to be valued require only to be known. During many years I sought a remedy in vain, was daily becoming weaker, but when I heard of your Pills, and had recourse to them, they soon restored me."

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, W.C.

EVERY THURSDAY, PRICE 4d.

"NATURE."

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 o'clock on Wednesdays.

Post-office Orders payable to MACMILLAN & CO.

OFFICE: BEDFORD STREET, STRAND, W.C.

BRYANT & MAY'S
MATCHES.

SCIENTIFIC WORKS.

Owens College Essays.—Essays and Addresses by Professors and Lecturers of the Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. 8vo, 14s.

A series of papers bearing on such questions of literature, science, and politics as are of special interest at the present time, and written by men who are fully competent to deal with the various subjects. The following are specimens of the papers:—Original Research as a Means of Education, by Prof. Roscoe; Solar Physics, by Prof. Balfour Stewart; On some Relations of Culture to Practical Life, by Prof. Greenwood; Some Historical Results of the Science of Language, by Prof. Wilkins; The Judicature Act of 1873 in its Relation to the History of the Judicial System in England, by Prof. Bryce; The Railways and the State, by Prof. Stanley Jevons; The Peace of Europe, by Prof. Ward, &c.

Rendu's Theory of the Glaciers of Savoy. Translated by ALFRED WILLS, Q.C., late President of the Alpine Club. To which are added the Original Memoir and Supplementary Articles, by Professors TAIT and RUSKIN. Edited, with Introductory Remarks, by GEORGE FORBES, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. 8vo, 7s. 6d. [This day.

The Principles of Science. By Prof. JEVONS, F.R.S. A Treatise on Logic and Scientific Method. Two vols. 8vo, 25s.

Elements of Physical Manipulation. By EDWARD C. PICKERING, Professor of Physics in the Massachusetts Institute of Technology. Part I. 8vo, 10s. 6d.

The Beginnings of Life: being some Account of the Nature, Modes of Origin, and Transformation of Lower Organisms. By H. CHARLTON BASTIAN, M.D., F.R.S. With upwards of 100 Illustrations. 2 vols. crown 8vo, 28s.

First Principles of Chemical Philosophy. By J. P. COOKE, JUN., Ervine Professor of Chemistry and Mineralogy in Harvard College. Crown 8vo, 12s. Third Edition, revised and corrected.

Acadian Geology. The Geologic Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island. By J. W. DAWSON, LL.D., F.R.S., Principal of McGill College and University, Montreal. Second Edition, revised and enlarged. With Geological Map and Illustrations, 8vo, 18s.

Hereditary Genius: an Inquiry into its Laws and Consequences. By FRANCIS GALTON, F.R.S. 8vo. 12s.

The Theory of Evolution of Living Things, and the Principles of Evolution applied to Religion, considered as illustrative of the Wisdom and Beneficence of the Almighty. By the Rev. GEORGE HENSLOW, M.A., F.R.S. Crown 8vo, 6s.

The Student's Flora of the British Islands. By J. D. HOOKER, C.B., F.R.S., President of the Royal Society. Globe 8vo, 10s. 6d.

Professor Huxley's Lay Sermons, Addresses, and Reviews. New and cheaper Edition, 7s. 6d.

Professor Huxley's Critiques and Addresses. 8vo, 10s. 6d.

On the Genesis of Species. By St. George MIVART, F.R.S. Second Edition, with Notes in reference and reply to Darwin's "Descent of Man." With numerous Illustrations. Crown 8vo, 9s.

The Scientific Bases of Faith. By J. J. MURPHY. 8vo, 14s.

Sound and Music: a Non-mathematical Treatise on the Physical Constitution of Musical Sounds and Harmony, including the chief Acoustical Discoveries of Professor Helmholtz. By SEDLEY TAYLOR, M.A. Crown 8vo, 8s. 6d.

MACMILLAN & CO., LONDON.

KING'S COLLEGE, LONDON.

The THEOLOGICAL DEPARTMENT.—New Students must present themselves on TUESDAY, September 29.

The College Theological Testamur can be obtained by

A. Graduates in Arts of any British University, in three terms.

B. Associates of the General Literary Department of King's College, in six terms.

C. All duly qualified persons of 21 years of age, in six terms.

Two Studentships of the value of £30 for two years will be adjudged by examination to those entering the College in October next.

There is also a Preparatory Class for those wishing to pass the Entrance Examinations.

For information, apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

KING'S COLLEGE, LONDON.

DEPARTMENT of GENERAL LITERATURE and SCIENCE.—New Students will be admitted on WEDNESDAY, September 30.

The Department is thus divided:—

1. The Classical Division (embracing Classics, Mathematics, English History, and Modern Languages).

2. The Modern Division, which includes English, Latin, Modern Languages, Mathematics, Natural Philosophy, Chemistry, Geology, and Free-hand Drawing.

One Freake Exhibition of £20 will be given at the commencement of the Michaelmas Term to the Student passing the best examination on entering the College.

For information, apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

KING'S COLLEGE, LONDON.

DEPARTMENT of ENGINEERING and APPLIED SCIENCES.—New Students will be admitted on WEDNESDAY, September 30.

The course of study provides practical education for young men who intend to engage in engineering, surveying, architecture, telegraphy, and the higher branches of chemical and manufacturing art.

This Department has attached to it a workshop, also chemical, physical, and photographic laboratories.

One Freake and two College Exhibitions of £20, £30, and £21 respectively, will be given at the commencement of the Michaelmas Term to the Students passing the best examination on entering the College.

For information, apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

KING'S COLLEGE, LONDON.

MEDICAL DEPARTMENT.—The WINTER SESSION will OPEN on THURSDAY, Oct. 1, with an Introductory Lecture by Dr. FERRIER.

Warneford Scholarships.—Students entering in October next will have the privilege of contending for two Scholarships of £25 each for three years.

Five Medical Scholarships are awarded at the close of each winter session for proficiency in professional subjects, viz., one of £40 for two years, one of £30 for one year, and three of £20 for one year.

For further information apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

KING'S COLLEGE, LONDON.

The EVENING CLASSES.—These Classes will RE-OPEN on MONDAY, October 5, in Divinity, Latin, Greek, French, German, Hebrew, Italian, Spanish, German Literature, English Literature and Composition, English History, Geography, Arithmetic, Writing, Mathematics, Commerce, Drawing, Chemistry, Practical Chemistry, Mechanics, Physiology, Physics, Botany, Zoology, Logic, Political Economy, Mineralogy, Geology, Law, and Public Speaking.

For the prospectus, apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

KING'S COLLEGE, LONDON.

The SCHOOL.—New Pupils will be admitted on TUESDAY, September 22. There are four divisions:—

1. Upper Classical School, intended to prepare Pupils for the Universities, for the theological, general literature, and medical departments of the College, and for the learned professions.

2. Upper Modern School, intended to prepare Pupils for general and mercantile pursuits, for the department of Engineering in the College, and for the Military Academies.

3. The Middle School comprises several Classes, each with its classical and modern division, for Pupils who are too old for the Lower, but not sufficiently advanced for the Upper School. Great attention is paid in this Division to arithmetic, writing, and bookkeeping, and to the subjects required for the Home Civil Service Examinations and those for mercantile appointments.

4. Lower School.—This Division includes boys over eight years of age, and is intended to give a complete course of education up to such a point as will prepare them to enter with advantage either of the two senior divisions.

For information, apply, personally or by post-card, to J. W. Cunningham, Esq., Secretary.

THE LONDON HOSPITAL AND MEDICAL COLLEGE.

The next WINTER SESSION will commence on THURSDAY Oct. 1st, 1874, when the Introductory Lecture will be given at 3 p.m. by SAMUEL FENWICK, M.D., Assistant Physician to the Hospital.

General Fee to Lectures, with two years' Practical Anatomy, and Hospital Practice, 90 guineas, payable in two instalments of 45 guineas each. Library Fee, £1 1s. Special entries can be made to Lectures or Practice.

The Hospital contains 600 beds. There are Medical and Surgical Wards for Children, Wards for Syphilis, Special Departments for Diseases of Women, Diseases of the Eye, Diseases of the Ear, Diseases of the Skin and special arrangements for Diseases of the Throat. A Maternity Department exists for the delivery of lying-in women at their own homes. 586 cases were attended last year by the Students of the Hospital.

For instruction in Mental Diseases, Students can attend without further fee the practice of Dr. John Millar, Superintendent of Bethnal House Asylum, a few minutes' walk from the Hospital.

Clinical Lectures, both Medical and Surgical, will be given every week, and practical instructions imparted in all the departments.

The In-patients during 1873 were 5,613, and the Out-patients 43,808; total, 49,421.

At the Medical College, which has been enlarged, Lectures will be given on all the subjects required by the Examining Boards.

Members of the Staff and Lecturers at the College.

Mr. J. Luke, F.R.S.
Mr. John Adams
Mr. Curling, F.R.S.
Dr. Herbert Davies
Dr. Andrew Clark
Dr. Ramskill
Dr. Langdon Down
Dr. Hughlings-Jackson
Dr. Sutton
Dr. Fenwick
Dr. Woodman
Dr. Stephen Mackenzie
Dr. A. E. Sansom
Mr. Jonathan Hutchinson
Mr. Maunder
Mr. Couper
Mr. Walter Rivington
Mr. Jas. Adams
Mr. Waren Tay
Mr. McCarthy
Mr. Reeves
Dr. Head
Dr. Palfrey
Mr. H. J. Barrett
Mr. A. W. Barrett
Dr. Letheby
Dr. Meymott Tidy
Dr. Prosser James
Dr. Morell-Mackenzie
Mr. J. E. D. Rogers
Mr. Gilbert Baker

The following Prizes and Appointments are open without any further payment to Students paying the general fee of 90 guineas:—

Seven Scholarships, to be offered for competition in the Winter Session:

1. A Scholarship of £30 to the Student of less than three months' standing who passes in October the best examination in the subjects required at the Preliminary Examination.
2. A Scholarship of £20 to the Student of less than three months' standing placed second in the above examination.
3. A Scholarship of £20 in Human Anatomy for first-year Students; to be awarded in April 1875.
4. A Scholarship, value £25, in Anatomy, Physiology, and Chemistry, for first-year and second-year Students; to be awarded in April 1875.
5. A Hospital Scholarship, value £20, for Clinical Medicine; to be awarded in April 1875.
6. A Hospital Scholarship, value £20, for Clinical Surgery; to be awarded in April 1875.
7. A Hospital Scholarship, value £20, for Clinical Obstetrics, to be awarded in April 1875; and a Prize of £5 to the Student who has attended most Midwifery Cases for the Hospital during the preceding twelve months.

The Duckworth Nelson Prize, value £10, for Practical Medicine and Surgery (Biennial), 1875.

Money Prizes to the value of £60 given annually by the House Committee for zeal in Dressing Out-patients and knowledge of Minor Surgery.

Certificates of Honour in all the Classes according to the results of the General Examinations at the end of the Session, and Special Certificates to those who have filled with credit the duties of the Hospital Appointments.

Four House-Surgeoncies, tenable for three or six months, and Dresserships to In-patients, open to all.

Dresserships to Out-patients, with the privilege of competing for the Prizes above mentioned.

The office of the Resident Medical Officer, tenable for two years, with a salary of £75 the first year, and £100 the second year.

The Office of Junior Resident Medical Officer, tenable for six months.

Four Medical Assistantships, held for three months, with residence and board in the Hospital for three weeks.

The office of Resident Accoucheur, tenable for six months.

N.B.—The holders of all the resident offices are provided with rooms and board free of expense.

Four offices of Clinical Assistants in the Out-patients' Department, each at a salary of £40.

The office of Medical Registrar, salary 25 guineas.

The office of Surgical Registrar, salary 35 guineas.

Prosectors of Anatomy, Ward Clerks, and Post-mortem Clerks.

A Prospectus, giving details, will be forwarded on application to the Bedell of the London Hospital Medical College, Turner Street, E.

Further information may also be obtained from Mr. James E. Adams, Treasurer, 10, Finsbury Circus, E.C.; or Mr. Waren Tay, Vice-Dean, at the Medical College.

DR LIONEL BEALE'S WORKS.

1. PROTOPLASM—1. Dissentient. 2. Demonstrative. 3 Speculative. 16 Plates, 10*s.* 6*d.* Now ready, Third Edition. J. & A. CHURCHILL
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6*s.* 6*d.* J. & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition 28 Plates, 12*s.* 6*d.* J. & A CHURCHILL
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS Third Edition, 25*s* J. & A CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3*s* 6*d.* J & A CHURCHILL
6. The MICROSCOPE in MEDICINE. Fourth Edition, much enlarged. J. & A. CHURCHILL [In the Press
7. HOW to WORK with the MICROSCOPE 21*s* HARRISON, Pall Mall.

Now ready, 8vo, 10*s.* 6*d.*

CLINICAL MEDICINE,

Lectures and Essays

By BALTHAZAR FOSTER, M.D. F.R.C.P.,

Professor of Medicine in Queen's College, Physician to the General Hospital, Birmingham.

"The book may be taken up with advantage and profit, read with confidence as to its genuineness, and laid down with a feeling of admiration of the author's appreciation of clinic l facts, and his facile and reasonable method of putting them."—*British Medical Journal.*

J. & A. CHURCHILL, New Burlington Street

KIRKES' PHYSIOLOGY.

Eighth Edition, with 250 Illustrations, post 8vo, 12*s* 6*d.*

HANDBOOK of PHYSIOLOGY. By WILLIAM SENHOUSE KIRKES, M D. Eight Edition. Revised and Edited by W. MORRANT BAKER, F R C S, Lecturer on Physiology and Assistant-Surgeon to the St Bartholomew's Hospital, and Surgeon to the Evelina Hospital for Sick Children.

JOHN MURRAY, Albemarle Street.

18mo, price 1*s.*, free by post, 1*s* 2*d.*

NEW FRENCH-ENGLISH PRONOUNCING DICTIONARY, on the basis of Nugent's, with many new words in general use; exhibiting the pronunciation of all French words in pure English sound, and giving the parts of speech, and gender of French nouns. By a Member of the University of Paris

*** The cheapest French Dictionary in the world.

London: WILLIAM TEGG & CO, Pancras Lane, Cheapside.

Nearly ready, in 8vo, cloth

INAUGURAL ADDRESS to the British Association for the Advancement of Science, at Belfast, August 19, 1874 By JOHN TYNDALL, President.

London: LONGMANS & CO.

Now ready, Second Edition, crown 8vo, price 7*s.* 6*d.*

PHILOSOPHY, SCIENCE, and REVELATION. By the Rev C. B. GIBSON, M R I.A Lecturer, St. John's, Hoxton.

London: LONGMANS & CO.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

NEW BOOKS.

This day, in 8vo, price 21*s.*

TELEGRAPH and TRAVEL. A Narrative of the Formation and Development of Telegraphic Communication between England and India, under the Orders of Her Majesty's Government; with Incidental Notices of the Countries traversed by the Lines By Colonel Sir FREDERIC GOLDSMID, C B K C.S.I., late Director of the Government Indo-European Telegraph With numerous Illustrations and Maps.

DEDICATED BY SPECIAL PERMISSION TO THE QUEEN.

MENDELSSOHN. By Ferdinand Hiller. Letters and Recollections Translated by M E. VON GLEHN. With Lithographic Portrait from a Drawing by Carl Müller, never before published Crown 8vo, 7*s.* 6*d.* [This day.

TECHNICAL TRAINING. By Thomas TWINING (one of the Vice-Presidents of the Society of Arts) Being a Suggestive Sketch of a National System of Industrial Instruction, founded on a general diffusion of Practical Science among the People 8vo, 12*s.* [This day.

BIRDS: their Cages and their Keep. Being a Practical Manual of Bird-keeping and Bird-rearing. By K A. BUIST. With Coloured Frontispiece and other Illustrations. Crown 8vo, 5*s.* [This day.

DISESTABLISHMENT AND DISENDOWMENT, WHAT ARE THEY? By EDWARD A. FREEMAN, D.C.L. Crown 8vo, 2*s.* 6*d.* [This day.

PRIMER of PHYSIOLOGY. By Dr. MICHAEL FOSTER, F.R.S. With numerous Illustrations, 18mo, cloth, 1*s.* (Macmillan's "Science Primers") [This day.

The BIRDS of ARISTOPHANES. Translated into English Verse, with Introduction, Notes, and Appendices, by B H KENNEDY, D.D, Regius Professor of Greek in the University of Cambridge. Crown 8vo, 6*s.* [This day.

ESSAYS and ADDRESSES, by PROFESSORS and LECTURERS of Owens College, Manchester Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873 8vo, 14*s.* [This day.

WORDSWORTH, SHELLEY, KEATS, and other ESSAYS. By Professor MASSON Crown 8vo, 5*s.* [This day.

A GRAMMAR of the LATIN LANGUAGE. By H J. ROBY, M A., late Fellow of St. John's College, Cambridge In Two Parts Part II Syntax, Prepositions, &c, crown 8vo, 10*s.* 6*d.* (Part I—Second Edition, 8*s.* 6*d*) [This day.

MODERN UTILITARIANISM; or, the Systems of Paley, Bentham, and Mill examined and compared. By T. R. BIRKS, M.A, Professor of Moral Philosophy at Cambridge Crown 8vo. [Just ready.

ELEMENTARY LESSONS in PHYSICAL GEOGRAPHY By ARCHIBALD GEIKIE, F.R S., Professor of Geology at Edinburgh. With numerous Illustrations.

ELEMENTARY LESSONS in GEOLOGY. By Professor GEIKIE.

MACMILLAN & CO., LONDON.

MACMILLAN & CO.'S

GOLDEN TREASURY SERIES.

Uniformly Printed in 18mo., with Vignette Titles by Sir NOEL PATON, T. WOOLNER, W. HOLMAN HUNT, J. E. MILLAIS, ARTHUR HUGHES, &c. Engraved on Steel by JEENS. Bound in extra cloth, 4*s.* 6*d.* each volume. Also kept in morocco and calf bindings.

"*Messrs. Macmillan have, in their Golden Treasury Series, especially provided editions of standard works, volumes of selected poetry, and original compositions, which entitle this series to be called classical. Nothing can be better than the literary execution, nothing more elegant than the material workmanship.*"—British Quarterly Review.

The Golden Treasury of the Best Songs and Lyrical Poems in the English Language. Selected and arranged, with Notes, by FRANCIS TURNER PALGRAVE.

"*This delightful little volume, the Golden Treasury, which contains many of the best original lyric pieces and songs in our language, grouped with care and skill, so as to illustrate each other like the pictures in a well-arranged gallery.*"—Quarterly Review.

The Children's Garland from the best Poets. Selected and arranged by Coventry Patmore.

"*It includes specimens of all the great masters in the art of poetry, selected with the matured judgment of a man concentrated on obtaining insight into the feelings and tastes of childhood, and desirous to awaken its finest impulses, to cultivate its keenest sensibilities.*"—Morning Post.

The Book of Praise. From the best English Hymn Writers. Selected and arranged by Sir ROUNDELL PALMER. A New and Enlarged Edition.

The Fairy Book; the best Popular Fairy Stories. Selected and rendered anew by the Author of "John Halifax, Gentleman."

"*A delightful selection, in a delightful external form; full of the physical splendour and vast opulence of proper fairy tales.*"—Spectator.

The Ballad Book. A Selection of the Choicest British Ballads. Edited by William ALLINGHAM.

"*His taste as a judge of old poetry will be found, by all acquainted with the various readings of old English ballads, true enough to justify his undertaking so critical a task.*"—Saturday Review.

The Jest Book. The Choicest Anecdotes and Sayings. Selected and arranged by Mark LEMON.

"*The fullest and best jest book that has yet appeared.*"—Saturday Review.

Bacon's Essays and Colours of Good and Evil. With Notes and Glossarial Index. By W. ALDIS WRIGHT, M.A.

The Pilgrim's Progress from this World to that which is to come. By John Bunyan.

"*A beautiful and scholarly print.*"—Spectator.

The Sunday Book of Poetry for the Young. Selected and arranged by C. F. Alexander.

"*A well-selected volume of sacred poetry.*"—Spectator.

A Book of Golden Deeds of all Times and all Countries. Gathered and narrated anew. By the Author of "The Heir of Redclyffe."

The Poetical Works of Robert Burns. Edited, with Biographical Memoir, Notes, and Glossary, by Alexander Smith. Two vols.

The Adventures of Robinson Crusoe. Edited from the Original Edition by J. W. Clark, M.A., Fellow of Trinity College, Cambridge.

The Republic of Plato. Translated into English, with Notes by J. Ll. Davies, M.A., and D. J. VAUGHAN, M.A.

The Song Book. Words and Tunes from the best Poets and Musicians. Selected and arranged by John Hullah, Professor of Vocal Music in King's College, London.

La Lyre Francaise. Selected and arranged, with Notes, by Gustave Masson, French Master in Harrow School.

Tom Brown's School Days. By An Old Boy.

A Book of Worthies. Gathered from the Old Histories and written anew by the Author of "The Heir of Redclyffe."

MACMILLAN & CO., LONDON.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD —Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c. gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25*s* to 45*s*. Alberts, 2*s*. to 5*s*; Long Chains, 5*s*. to 8*s*. 6*d*.; Lockets, 2*s*. to 5*s*. 6*d*.; Crosses, 1*s*. 6*d*. to 4*s*. 6*d*.; Ladies' Gem Rings, 2*s*. to 2*s*.; Wedding and Keeper Rings, 1*s*. to 2*s*. 6*d*.; Gents' Finger Rings, 2*s*. 6*d*. to 6*s*.; Bracelets, 5*s* to 10*s*. 6*d*.: Studs, 1*s*. to 3*s* 6*d*.; Links, 1*s*. to 3*s*; Breast Pins, 1*s*. to 4*s*. 6*d*, Brooches, 1*s*. 6*d*. to 7*s*. 6*d*; Ear Rings, 1*s*. 6*d* to 6*s* 6*d*.: Sets (*en suite*), Brooch and Ear Rings, 5*s* 6*d* to 10*s* 6*d*; Pencil Cases, 2*s* to 4*s* 6*d*.; Gents' Snake Rings (Plain Head), 3*s* 6*d*, Head set with Brilliant, &c., 5*s*

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices, we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "MAZELINE" GOLD JEWELLERY to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P O O to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½*d*., 1*s*. 1½*d*., and 2*s*. 9*d*. Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2*s*. 9*d*. box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

⁂ The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation, and all the symptoms of Impending Consumption.

LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2*s*. 9*d*. by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

⁂ Order of any Chemist.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s*., 21*s*., 26*s*. 6*d*., and 31*s*. 6*d*.
" Double " 31*s*. 6*d*, 42*s*., and 52*s*. 6*d*.
" Umbilical " 42*s* and 52*s*. 6*d*.
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s*. 6*d*., 7*s*. 6*d*., 10*s*., and 16*s*. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

TISLEY'S

PENDULUM APPARATUS,

	£	s	d
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern, packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

L. OERTLING,

TURNMILL STREET, NEAR FARRINGDON STREET STATION

(LATE OF 27, MOORGATE STREET, CITY),

MANUFACTURER OF

CHEMICAL, ASSAY, AND BULLION BALANCES.

Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c.

By Appointment

Hydrometer and Saccharometer Maker to the Board of Inland Revenue.

Council Medal, 1851. *First Class Medal*, 1854 *and* 1862.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin, also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

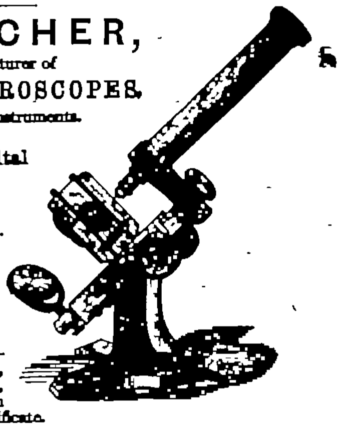
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.



Pillischer's St. Thomas's Hospital Microscope,

As supplied to the principal Universities and Hospitals.

Monocular, £5, Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/16 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14s.; 4½ in., 17s.; 6 in., in Wooden Case, 10s., including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. Ellis & Son, Ruthin, North Wales.

LONDON AGENTS:—W. Best & Sons, Henrietta Street, Cavendish Square.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

Printed by R. Clay, Sons, & Taylor, at 7 and 8, Bread Street Hill, in the City of London, and published by Macmillan & Co., at the Office, 29 and 30, Bedford Street, Covent Garden.—Thursday, September 10, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

NO. 255, VOL. 10] THURSDAY, SEPTEMBER 17, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office

[All Rights are Reserved

UNIVERSITY COLLEGE, LONDON, SCHOOL.

Head-Master—T HEWITT KEY, M A. F R.S
Vice-Master—E. R. HORTON, M A., Fellow of St. Peter's College, Cambridge

The SCHOOL will RE-OPEN for New Pupils on TUESDAY, September 22, at 8 30 a m The School Session is divided into three equal Terms Fee, £8 per Term, to be paid at the beginning of each Term. Gymnastics, Fencing, Drilling, and Advanced Drawing, extra.

Extensive additional buildings, including spacious Lecture-rooms for the Classes of Chemistry and Experimental Physics, have recently been completed for the use of the Pupils attending the School

A Playground of about two acres in extent, including several Fives' Courts, is attached to the School.

Discipline is maintained without corporal punishment.

A monthly report of the progress and conduct of each pupil is sent to his parent or guardian

The School is close to the Gower Street Station of the Metropolitan Railway, and only a few minutes' walk from the Termini of the North-Western, Midland, and Great Northern Railways. Season Tickets are granted at half-price to Pupils attending the School

A Prospectus, containing full information respecting the Courses of Instruction given in the School, with other particulars, may be obtained at the Office of the College.

JOHN ROBSON, B A
August 1874 Secretary to the Council

UNIVERSITY HALL, GORDON SQUARE, LONDON, W.C.

Principal and Classical Tutor—E S. BEESLY, M A. Oxon., Professor of History in University College, London
Vice-Principal and Mathematical Tutor—J J. WALKER, M A, Trin. Coll, Dublin.

Students at University College are received into the Hall, and reside under collegiate discipline Some of the sets of rooms are now vacant, at rents varying from £12 to £48 for the Session. Satisfactory references will be required by the Principal from all gentlemen desiring to be admitted into the Hall

The Hall will RE-OPEN on the 5th of October next, the day on which the Session of the Faculties of Arts and Laws and of Science will begin at University College, in close proximity to which it is situated

SCHOLARSHIPS.—The Trustees of the Gilchrist Educational Fund have founded Three Scholarships of £50 per annum each, tenable for three years, by Students residing in the Hall, one being awarded every year to the candidate passing highest in the June Matriculation Examination of the University of London

Prospectuses containing further information may be obtained on written application addressed to the Principal, or to the Secretary at the Hall

September 1874.

PRELIMINARY EXAMINATIONS of the COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr. J ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations. For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c., address to 3, Pump Court, Temple, or to the care of Messrs Butterworth, 7, Fleet Street, her Majesty's Publishers.

ROYAL SCHOOL OF MINES.

DEPARTMENT OF SCIENCE AND ART.

During the Twenty fourth Session, 1874–75, which will commence on the 1st of October, the following COURSES of LECTURES and PRACTICAL DEMONSTRATIONS will be given :—

1. Chemistry By E Frankland, Ph D. F R.S.
2. Metallurgy By John Percy, M.D F R S
3. Natural History. By T. H. Huxley, LL D F R S
4. Mineralogy } By Warington W Smyth, M A F R.S, *Chairman*
5. Mining }
6. Geology By A. C Ramsay, LL.D. F R S.
7. Applied Mechanics By T M Goodeve, M A.
8. Physics., By Frederick Guthrie, Ph D. F R.S.
9. Mechanical Drawing. By Rev. J. H. Edgar, M.A.

The Fee for Students desirous of becoming Associates is £30 in one sum, on entrance, or two annual payments of £20, exclusive of the Laboratories.

Tickets to separate Courses of Lectures are issued at £3 and £4 each

Officers in the Queen's Service, Her Majesty's Consuls, Acting Mining Agents, and Managers, may obtain Tickets at reduced prices.

Science Teachers are also admitted to the Lectures at reduced fees.

For a Prospectus and information apply to the Registrar, Royal School of Mines, Jermyn Street, London, S.W.

TRENHAM REEKS, Registrar.

NOTE —By order of the Lords of the Committee of Council on Education, the instruction in Chemistry, Physics, Applied Mechanics, and Natural History will be given in the New Buildings in the Exhibition Road, South Kensington.

LONDON LIBRARY,

12, ST. JAMES'S SQUARE —Founded in 1841.

Patron—H.R.H. THE PRINCE OF WALES.

President—THOMAS CARLYLE, ESQ.

This Library contains 90,000 Volumes of Ancient and Modern Literature, in various Languages Subscription, £3 a year, or £2 with Entrance Fee of £6, Life Membership, £26.

Fifteen Volumes are allowed to Country, and Ten to Town Members. Reading Room open from Ten to half-past Six. Prospectus on application Catalogue, New Edition, in the press.

ROBERT HARRISON, Secretary and Librarian.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus, F.R.S. ; Dr. Frankland, F.R S. ; Dr. Roscoe, F.R S ; Dr. Angus Smith, F.R.S. ; Dr. Tyndall, F.R.S. ; Dr. Voelcker, F.R.S. ; Dr. Williamson, F.R.S

C WILLMORE, Principal.

ROYAL COLLEGE of SCIENCE for IRELAND, STEPHEN'S GREEN, DUBLIN.

SCIENTIFIC AND TECHNICAL EDUCATION.

This College supplies a complete course of instruction in Science, applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course

There are Four Royal Scholarships, of the value of £50 each yearly, with free education, including Laboratory instruction, tenable for two years Two become vacant each year. They are given to Students who have been a year in the College

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory

Chemistry (Theoretical and Practical), Metallurgy, &c.—Professor Robert Galloway, F.C S
Mathematics, Mechanics, and Mechanism—Professor Robert Ball, LL.D. F.R S.
Drawing, Engineering, and Surveying—Professor Thomas F. Pigot, C E. M R I.A.
Experimental Physics—Professor W. F. Barrett, F.R S.E. F.C.S.
Geology—Professor Edward Hull, M A F.R S.
Mining and Mineralogy—Professor J. P. O'Reilly, C E. M.R.I.A.
Agriculture—Professor Edmund W. Davy, M.D. M.R.I.A.
Botany—Professor W R. M'Nab, M D.
Zoology—Professor H. Alleyne Nicholson, M D.

The Session commences on MONDAY, October 5th

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin

FREDERICK J SIDNEY, LL D., Secretary.

CRYSTAL PALACE COMPANY'S

SCHOOL OF ART, SCIENCE, AND LITERATURE.

LADIES' DIVISION.

The FIFTEENTH SESSION will OPEN on THURSDAY, October 15th.

Water-colour Painting, Sketching, &c.	Mr. Edward A. Goodall.
Figure Drawing, the Antique, &c., Modelling in Clay, &c.	Mr. W. K Shenton.
Painting in Oils, from the Life, &c. ...	Mr. C. Armytage.
English Language and Literature ...	Rev Alfred Ainger, M.A.
French Language and Literature ...	Professor A. Mandrou, M A.
German Language and Literature ...	Dr Heinemann, F.R.G.S.
Italian Language and Literature ...	Cavalier Professor G. Volpe.
Latin	Rev. Alfred Ainger, M.A.
General History	Dr. G. G. Zerffi, F.R. Hist. Soc.
Physical Geography, Arithmetic, and Mathematics.	Mr. A Sonnenschein.
Experimental Physics	
Botany	Mr. Alfred W. Bennett, M.A. B Sc.
Pianoforte	Sir Julius Benedict, Mr. Lindsay Sloper, Mr Arthur Sullivan, M. E. Prout, B.A
Harmony and Musical Analysis... ...	Dr John Stainer, M A.
Composition	Dr John Stainer, M.A.
Singing	Mme. St Germaine, Signor Risalli.
Ballad Singing...	Mr. Arthur Sullivan.
Cookery and Domestic Economy ...	Miss Mary Hooper.
Dancing	M. Louis d'Egville. Mrs. George Gilbert.
Artistic Wood Carving	Mr. G. A. Rogers

The Studios and Class-rooms are strictly private.

Prospectus on application in the office of the School, in the Library, next the Reading-room, Byzantine Court, Crystal Palace, Sydenham.

By order of the Committee,

F. K. J. SHENTON,
Superintendent Literary Department.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

SCHOLARSHIPS IN SCIENCE.

Two Scholarships in Science have been founded at St. Bartholomew's Hospital:—

1. An Open Scholarship of the value of £100, tenable for one year, to be competed for in September The subjects of examination are Physics, Chemistry, Botany, and Zoology. The successful candidate will be required to enter at St. Bartholomew's Hospital in October next.

2. Preliminary Scientific Scholarship of the value of £50, tenable for one year, to be competed for in October next by Students of the Hospital of less than six months' standing. The subjects of examination are identical with those of the Open Scholarship.

For further particulars and syllabus of subjects, application may be made personally or by letter to the Warden of the College, St. Bartholomew's Hospital.

THE LONDON HOSPITAL AND MEDICAL COLLEGE.

The next WINTER SESSION will commence on THURSDAY, Oct. 1st, 1874, when the Introductory Lecture will be given at 3 p m. by SAMUEL FENWICK, M D, Assistant Physician to the Hospital.

General Fee to Lectures, with two years' Practical Anatomy, and Hospital Practice, 90 guineas, payable in two instalments of 45 guineas each. Library Fee, £1 1s. Special entries can be made to Lectures or Practice.

The Hospital contains 600 beds There are Medical and Surgical Wards for Children, Wards for Syphilis, Special Departments for Diseases of Women, Diseases of the Eye, Diseases of the Ear, Diseases of the Skin, and special arrangements for Diseases of the Throat A Maternity Department exists for the delivery of lying-in women at their own homes. 586 cases were attended last year by the Students of the Hospital.

For instruction in Mental Diseases, Students can attend without further fee the practice of Dr. John Millar, Superintendent of Bethnal House Asylum, a few minutes' walk from the Hospital.

Clinical Lectures, both Medical and Surgical, will be given every week, and practical instructions imparted in all the departments.

The In-patients during 1873 were 5,613, and the Out-patients 43,808; total, 49,421.

At the Medical College, which has been enlarged, Lectures will be given on all the subjects required by the Examining Boards.

Members of the Staff and Lecturers at the College.

Mr. J. Luke, F.R.S.
Mr. John Adams
Mr. Curling, F.R S.
Dr. Herbert Davies
Dr Andrew Clark
Dr. Ramskill
Dr. Langdon Down
Dr Hughlings-Jackson
Dr Sutton
Dr Fenwick
Dr. Woodman

Dr. Stephen Mackenzie
Dr. A. E. Sansom
Mr Jonathan Hutchinson
Mr Maunder
Mr. Couper
Mr. Walter Rivington
Mr. Jas Adams
Mr. Waren Tay
Mr McCarthy
Mr. Reeves

Dr. Head
Dr. Palfrey
Mr. H J Barrett
Mr A. W Barrett
Dr Letheby
Dr. Meymott Tidy
Dr. Prosser James
Dr Morell-Mackenzie
Mr. J. E. D. Rogers
Mr. Gilbert Baker

The following Prizes and Appointments are open without any further payment to Students paying the general fee of 90 guineas:—

Seven Scholarships, to be offered for competition in the Winter Session:

1. A Scholarship of £50 to the Student of less than three months' standing who passes in October the best examination in the subjects required at the Preliminary Examination.
2. A Scholarship of £20 to the Student of less than three months' standing placed second in the above examination.
3. A Scholarship of £20 in Human Anatomy for first-year Students; to be awarded in April 1875
4. A Scholarship, value £25, in Anatomy, Physiology, and Chemistry, for first-year and second-year Students; to be awarded in April 1875
5. A Hospital Scholarship, value £20, for Clinical Medicine; to be awarded in April 1875.
6. A Hospital Scholarship, value £20, for Clinical Surgery; to be awarded in April 1875.
7. A Hospital Scholarship, value £20, for Clinical Obstetrics, to be awarded in April 1875; and a Prize of £5 to the Student who has attended most Midwifery Cases for the Hospital during the preceding twelve months.

The Duckworth Nelson Prize, value £10, for Practical Medicine and Surgery (Biennial), 1875.

Money Prizes to the value of £60 given annually by the House Committee for zeal in Dressing Out-patients and knowledge of Minor Surgery.

Certificates of Honour in all the Classes according to the results of the General Examinations at the end of the Session, and Special Certificates to those who have filled with credit the duties of the Hospital Appointments.

Four House-Surgeoncies, tenable for three or six months, and Dresserships to In-patients, open to all.

Dresserships to Out-patients, with the privilege of competing for the Prizes above mentioned.

The office of the Resident Medical Officer, tenable for two years, with a salary of £75 the first year, and £100 the second year.

The Office of Junior Resident Medical Officer, tenable for six months.

Four Medical Assistantships, held for three months, with residence and board in the Hospital for three weeks.

The office of Resident Accoucheur, tenable for six months.

N B—The holders of all the resident offices are provided with rooms and board free of expense.

Four offices of Clinical Assistants in the Out-patients' Department, each at a salary of £40.

The office of Medical Registrar, salary 25 guineas.

The office of Surgical Registrar, salary 35 guineas.

Prosectors of Anatomy, Ward Clerks, and Post mortem Clerks.

A Prospectus, giving details, will be forwarded on application to the Bedell of the London Hospital Medical College, Turner Street, E.

Further information may also be obtained from Mr James E Adams, Treasurer, 10, Finsbury Circus, E.C.; or Mr. Waren Tay, Vice-Dean, at the Medical College.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

Opening of WINTER SESSION, October 1st, 1874. Introductory Address by Mr EDMUND OWEN.
For further particulars apply to the Registrar at the Hospital, or to

A. B. SHEPHERD, M.B., Dean of the School.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

THREE OPEN SCHOLARSHIPS and TWO EXHIBITIONS, October 1874.
For particulars apply to the Dean, St. Mary's Hospital, Paddington, W.

EVENING SCIENCE LECTURES.—Mr. W J WILSON, F C.S. F.P S (Demonstrator of Practical Physics at South Kensington), will commence the following Courses of Lectures in the Theatre of the Birkbeck Institution, Southampton Buildings, W C, on October 1st and 2nd.—

Acoustics, Light, and Heat, 30 Lectures, on Thursdays, at 8 p m.
Electricity and Magnetism, 30 Lectures, on Fridays, at 8 p m.

Fee for one Course, 5s.; for the two, 7s. 6d For detailed Syllabus, particulars of Special Prizes, &c, apply to the Librarian.
At the Class Examinations of the Science and Art Department, May 1874, 130 Papers in Physics were worked by Mr Wilson's Pupils. Of these, 87 passed First Class and obtained Queen's Prizes; 41 passed Second Class, and two failed. In 1873, 68 Papers worked: 45 First Class, 23 Second Class, and *none failed*.

MATRICULATION EXAMINATION, LOND. UNIV., January 1875.

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, READS WITH PUPILS for this Exam. He is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Exam, having passed fifty-seven Pupils, to whom reference can be given Two of these passed in the Honours list in January 1873, seventh and fourteenth respectively. A Class will commence early in September, and another early in October. Fees for the two, £14 and £10 10s. respectively. For further particulars, address 24, Old Square, Lincoln's Inn, W.C.—A few Residents can be accommodated in Mr. Hanbury's house at Clapham.

PRELIMINARY EXAMINATION IN ARTS, ROYAL COLL. SURG., December 1874

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, PREPARES PUPILS for this Exam. He is assisted by efficient Lecturers in French and Chemistry, and has passed several Pupils for this Exam, to whom reference can be given Terms from 8 to 12 Guineas, according to subjects taken up and time of joining the class. For further particulars, address 24, Old Square, Lincoln's Inn, W C.

EVENING SCIENCE LECTURES.—PHYSICAL GEOGRAPHY AND GEOLOGY.—Mr H. FISHER, F.G.S, will deliver, at the Birkbeck Institution, Southampton Buildings, Chancery Lane, a Course of Thirty Lectures on each of the above subjects, on THURSDAY EVENINGS at 7 and 8 o'clock respectively, commencing October 1st Fee for the Two Courses, 7s. 6d.; a Single Course, 5s.—For further particulars apply to Secretary.

MATHEMATICS and SCIENCE.—Pupils prepared for Competitive and Pass Examinations by a High Wrangler and Nat. Science Man Successful in Tuition. In the Country by Correspondence. Classes visited.—J. F BLAKE, 6, Wells Road, Regent's Park, N.W.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S A., 44, Berners Street, W

The SECOND MASTER of a High-class Grammar School receives a few Resident Pupils. Special attention is given to the study of Natural Sciences.—For further particulars apply by letter to "Tripos," care of the Publisher of NATURE, 29, Bedford Street, Strand, London, W.C.

TUITION in CLASSICS, ENGLISH LANGUAGE, HISTORY, and LITERATURE.—An experienced Tutor attends Schools and Families, in London or the Country, to teach the above Subjects. Prepares for the Public Schools, Universities, and the Army.—Address, TUTOR, 15, Gledhow Terrace, South Kensington, S.W.

TO NATURALISTS and GEOLOGISTS.—The ORFORD CASTLE COLLECTION OF CRAG FOSSILS. (See Advertisement in NATURE of June 18th) For particulars of these Collections address Fredc Collingwood, Esq, F.G S, 4, St Martin's Place, Trafalgar Square, superscribed "ORFORD CASTLE FUND"

July 8th.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c, of J. TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S, at his residence, 149, Strand, W.C.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 " ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s., Ladies' Chest Expanders from 5s 6d—SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

HOLLOWAY'S PILLS and OINTMENT.—A great and precious property possessed by Holloway's inestimable remedies is that no skill or experience is required for their successful administration. No education or intelligence is necessary for using them to advantage, beyond the capacity of understanding the plain and intelligible instructions accompanying each box and pot. For the cure of all internal and external ailments, Professor Holloway has considerately placed such printed rules round his remedies that error is impossible after they have been once read with attention. In these Pills there is nothing nauseous to the taste or trying to the most tender age or delicate constitution. They purify, regulate, and strengthen the entire human system.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative 16 Plates, 10s. 6d. Now ready, Third Edition. J. & A. CHURCHILL
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d. J & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12s. 6d. J. & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS Third Edition, 25s. J. & A. CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s. 6d. J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition, much enlarged. J. & A. CHURCHILL. [In the Press.
7. HOW to WORK with the MICROSCOPE. 21s. HARRISON, Pall Mall.

Now ready, 8vo, 10s. 6d.

CLINICAL MEDICINE,

Lectures and Essays.

By BALTHAZAR FOSTER, M.D. F.R.C.P.,

Professor of Medicine in Queen's College, Physician to the General Hospital, Birmingham.

"The book may be taken up with advantage and profit, read with confidence as to its genuineness, and laid down with a feeling of admiration of the author's appreciation of clinic l facts, and his facile and reasonable method of putting them."—*British Medical Journal.*

J. & A. CHURCHILL, New Burlington Street.

18mo, price 1s., free by post, 1s. 2d.

NEW FRENCH-ENGLISH PRONOUNCING DICTIONARY, on the basis of Nugent's, with many new words in general use; exhibiting the pronunciation of all French words in pure English sound, and giving the parts of speech, and gender of French nouns. By a Member of the University of Paris.

*** The cheapest French Dictionary in the world.

London: WILLIAM TEGG & CO., Pancras Lane, Cheapside.

Fully Illustrated, 2 vols. 8vo, cloth, £2 2s., on large paper (royal 8vo), £4 4s.

A HISTORY of the BRITISH HYDROID ZOOPHYTES. By THOMAS HINCKS, B.A.

"The work is thoroughly exhaustive of its subject."—*Athenæum.*

JOHN VAN VOORST, 1, Paternoster Row.

Now ready, with Engravings, post 8vo, 7s. 6d.

PRACTICAL CHEMISTRY and QUALITATIVE INORGANIC ANALYSIS. An Elementary Treatise specially adapted for use in the Laboratories of Schools and Colleges, and by Beginners. By FRANK CLOWES, B.Sc. Lond., Science Master at Queenwood College.

J. and A. CHURCHILL, New Burlington Street.

TISLEY'S

PENDULUM APPARATUS,

	£	s.	d.
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on — — — — — — — — —	£12	0	0
Reflectors for projecting the Figures on the Screen — —	2	12	6
N.B.—Specimen Curves, on card, post free — per dozen—	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3—	0	7	6
Ditto traced on blackened Glass, for the Lantern — per slide—	0	2	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

	£	s.	d.
For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution —	£5	5	0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

SCIENTIFIC WORKS.

Owens College Essays.—Essays and Addresses by Professors and Lecturers of the Owens College, Manchester. Published in Commemoration of the Opening of the New College Buildings, October 7th, 1873. 8vo, 14s.

A series of papers bearing on such questions of literature, science, and politics as are of special interest at the present time, and written by men who are fully competent to deal with the various subjects. The following are specimens of the papers:—Original Research as a Means of Education, by Prof Roscoe, Solar Physics, by Prof. Balfour Stewart; On some Relations of Culture to Practical Life, by Prof. Greenwood; Some Historical Results of the Science of Language, by Prof. Wilkins; The Judicature Act of 1873 in its Relation to the History of the Judicial System in England, by Prof. Bryce; The Railways and the State, by Prof. Stanley Jevons; The Peace of Europe, by Prof. Ward, &c.

Rendu's Theory of the Glaciers of Savoy. Translated by ALFRED WILLS, Q.C, late President of the Alpine Club. To which are added the Original Memoir and Supplementary Articles, by Professors TAIT and RUSKIN. Edited, with Introductory Remarks, by GEORGE FORBES, B.A, Professor of Natural Philosophy in the Andersonian University, Glasgow. 8vo, 7s. 6d. [This day.

The Principles of Science. By Prof. JEVONS, F.R.S. A Treatise on Logic and Scientific Method. Two vols. 8vo, 25s.

Elements of Physical Manipulation. By EDWARD C. PICKERING, Professor of Physics in the Massachusetts Institute of Technology. Part I. 8vo, 10s. 6d.

The Beginnings of Life: being some Account of the Nature, Modes of Origin, and Transformation of Lower Organisms. By H. CHARLTON BASTIAN, M.D. F.R.S. With upwards of 100 Illustrations. 2 vols. crown 8vo, 28s.

First Principles of Chemical Philosophy. By J. P. COOKE, jun., Ervine Professor of Chemistry and Mineralogy in Harvard College. Crown 8vo, 12s. Third Edition, revised and corrected.

Acadian Geology. The Geologic Structure, Organic Remains, and Mineral Resources of Nova Scotia, New Brunswick, and Prince Edward Island. By J. W. DAWSON, LL.D. F.R.S., Principal of McGill College and University, Montreal. Second Edition, revised and enlarged. With Geological Map and Illustrations, 8vo, 18s.

Hereditary Genius: an Inquiry into its Laws and Consequences. By FRANCIS GALTON, F.R.S. 8vo. 12s.

The Theory of Evolution of Living Things, and the Principles of Evolution applied to Religion, considered as Illustrative of the Wisdom and Beneficence of the Almighty. By the Rev. GEORGE HENSLOW, M.A. F.R.S. Crown 8vo, 6s.

The Student's Flora of the British Islands. By J. D. HOOKER, C.B. F.R.S., President of the Royal Society. Globe 8vo, 10s. 6d.

Professor Huxley's Lay Sermons, Addresses, and Reviews. New and cheaper Edition, 7s. 6d.

Professor Huxley's Critiques and Addresses. 8vo, 10s. 6d.

On the Genesis of Species. By St. George MIVART, F.R.S. Second Edition, with Notes in reference and reply to Darwin's "Descent of Man." With numerous Illustrations. Crown 8vo, 9s.

The Scientific Bases of Faith. By J. J. MURPHY. 8vo, 14s.

Sound and Music: a Non-mathematical Treatise on the Physical Constitution of Musical Sounds and Harmony, including the chief Acoustical Discoveries of Professor Helmholtz. By SEDLEY TAYLOR, M.A. Crown 8vo, 8s. 6d.

MACMILLAN & CO., LONDON.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	*s.*	*d.*
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & CO.

OFFICE: BEDFORD STREET, STRAND, W.C.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 19*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, W.C.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES, AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible])

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests.

Subscription, 16*s.* 6*d.* per annum, post free, dating from any quarter-day. Single Copies, 1*s.* each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations, Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10*s.* each, the succeeding vols. may be had separately or together at 7*s.* each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK
DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS
COCOA

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c —Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent, No. 2 Black for walnut, Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

Price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

CLARENDON PRESS PUBLICATIONS.

A TREATISE ON ELECTRICITY AND MAGNETISM. By J. CLERK MAXWELL, M.A F.R.S., Professor of Experimental Physics in the University of Cambridge. 2 vols. 8vo, £1 11s. 6d.

The GEOLOGY of the VALLEY of the THAMES. By JOHN PHILLIPS, M.A. F.R.S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo, 21s.

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum.*

VESUVIUS. By John Phillips, M.A., F.R.S. With numerous Maps and Illustrations. Crown 8vo, 10s. 6d.

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction. His plan has been successfully carried out, and has resulted in a work of high value."—*Pall Mall Gazette.*

DESCRIPTIVE ASTRONOMY. A Handbook for the General Reader, and also for practical Observatory work. With 224 Illustrations and numerous Tables By G F CHAMBERS, F.R.A.S, Barrister-at-Law. Demy 8vo, cloth, 856 pp., price 21s.

CHEMISTRY FOR STUDENTS. By A. W. WILLIAMSON, Phil. Doc. F.R.S., Professor of Chemistry, University College, London. New Edition, with Solutions. Extra fcap. 8vo, cloth, price 8s. 6d.

EXERCISES IN PRACTICAL CHEMISTRY. By A. G VERNON HARCOURT, M.A. F.R.S, Senior Student of Christ Church, and Lee's Reader in Chemistry; and H. G. MADAN, M.A, Fellow of Queen's College, Oxford Series I, Qualitative Exercises. Second Edition. Crown 8vo, price 7s. 6d.

AN ELEMENTARY TREATISE ON HEAT. By BALFOUR STEWART, LL.D F.R.S., Professor of Natural History in Owens College, Manchester. Ext. fcap 8vo, with numerous Woodcuts and Diagrams, 7s. 6d. New Edition, revised and enlarged.

"The publication of this manual is exceedingly well-timed, it includes within narrow limits the leading facts and principles of this younger-born of the Sciences, and for the mastery of the greater portion of the contents only requires ordinary intelligence on the part of the reader."—*Spectator.*

FORMS OF ANIMAL LIFE. Being Outlines of Zoological Classification based upon Anatomical Investigation, and illustrated by Descriptions and Specimens and of Figures. By G. ROLLESTON, M.D. F.R.S., Linacre Professor of Physiology, Oxford. Demy 8vo, price 16s.

A TREATISE on ACOUSTICS. By W. J. DONKIN, F.R.S, Savilian Professor of Astronomy in the University of Oxford. Crown 8vo, price 7s. 6d.

A SYSTEM OF PHYSICAL EDUCATION: Theoretical and Practical. With 346 Illustrations drawn by A. MACDONALD, of the Oxford School of Art. By ARCHIBALD MACLAREN, The Gymnasium, Oxford. Ext. fcap 8vo, price 7s. 6d.

"The work before us is one which should be in the hands of every schoolmaster and schoolmistress. It is marked in every line by good sense, and is so clearly written that no one can mistake its rules"—*Lancet.*

ELEMENTS OF NATURAL PHILOSOPHY. By Sir W. THOMSON, LL.D. D.C.L. F.R.S, Professor of Natural Philosophy, Glasgow; and P. G. TAIT, M.A., Professor of Natural Philosophy, Edinburgh. Part I, 8vo, 9s.

Oxford: Printed at the Clarendon Press, and Published by MACMILLAN & CO., London, Publishers to the University.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s to 45s Alberts, 2s to 5s; Long Chains, 5s. to 8s 6d.; Lockets, 2s. to 5s. 6d.; Crosses, 1s. 6d. to 4s. 6d.; Ladies' Gem Rings, 2s. to 12s.; Wedding and Keeper Rings, 1s. to 2s. 6d; Gents' Finger Rings, 2s 6d to 6s, Bracelets, 5s to 10s. 6d; Studs, 1s. to 3s 6d; Links, 1s to 3s.; Breast Pins, 1s to 4s 6d, Brooches, 1s 6d. to 7s. 6d; Ear Rings, 1s 6d to 6s. 6d: Sets (*en suite*), Brooch and Ear Rings, 5s. 6d. to 10s 6d.; Pencil Cases, 2s to 4s 6d; Gents' Snake Rings (Plain Head), 3s. 6d, Head set with Brilliant, &c, 5s

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions

N.B.—Every watch is guaranteed for two years Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "MAZELINE" GOLD JEWELLERY to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P O O to be made payable at Post Office, Bishopsgate Street Without, London, E C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½d., 1s. 1½d., and 2s. 9d. Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2s. 9d. box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

\ₓ The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation and all the symptoms of Impending Consumption.

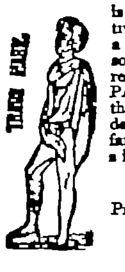
LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2s. 9d. by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

\ₓ Order of any Chemist.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS



is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s, 21s., 26s. 6d., and 31s. 6d. } Post-free.
„ Double „ 31s. 6d, 42s., and 52s. 6d.
„ Umbilical „ 42s and 52s. 6d.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

SUB-WEALDEN EXPLORATION

At Netherfield, near Battle.

The object of this work, commenced on the occasion of the meeting of the British Association at Brighton in 1872, is to ascertain the thickness of the Secondary Strata in the Wealden area, and the depth and nature of the underlying Palæozoic Formations.

The determination of the underground structure of the Wealden, is a point of great scientific interest, and one of *great national and economical importance*, as it may help to indicate the line taken underground by the coal-measures of Belgium and Somerset.

A sum of £3,000 has been collected by private subscription, and spent in this research, and a depth of 1,000 ft reached, but as yet without any positive result. The beds traversed belong to the Lower Wealden, Purbeck and Portland series, Kimmeridge clay, and the boring has now reached the Oxford clay.

It is most desirable that the work should not be discontinued in the present stage for want of funds, and the Committee therefore make an earnest appeal for further assistance.

Subscriptions may be sent to HENRY WILLETT, Esq., Hon. Sec. and Treasurer, Arnold House, Brighton.

Signed, on behalf of the Committee,

ANDREW RAMSAY,
JOHN EVANS,
JOSEPH PRESTWICH.

E. DENT & CO., 61, Strand, & 34, Royal Exchange

(FACTORY, SAVOY ST.), LONDON.

MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,

TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.

MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.

MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.

Catalogues or Estimates on Application.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr Lankester, September 10, 1867; Dr. Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10s and upwards Portable Filters on this system, £1 5s to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s. 6d. and 21s. each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,

157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2d.

NOW READY.

PRICE 1s.

NEW VOLUME OF "SCIENCE PRIMERS."

PRIMER OF PHYSIOLOGY.

BY

MICHAEL FOSTER, M.A., M.D., F.R.S.,

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

With Illustrations.

MACMILLAN & CO., LONDON.

A FEW ARTIST'S PROOFS

OF THE

PORTRAIT of PROF. TYNDALL, F.R.S., D.C.L., LL.D.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.

PRICE 5s. EACH,

OR THROUGH ANY BOOKSELLER.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and FLESH-FORMING QUALITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading. Price 6d. per month, or 5s. per annum, post-free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7s. 6d. each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOIL, by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co., at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, September 17, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 256, VOL. 10] THURSDAY, SEPTEMBER 24, 1874 [PRICE FOURPENCE

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

NOTICE.—ROYAL SCHOOL of MINES,

Jermyn Street, London.—The 24th SESSION will begin on THURSDAY, the 1st October.

Prospectuses may be had on application.

TRENHAM REEKS, Registrar.

UNIVERSITY OF LONDON.

MATRICULATION AND PRELIMINARY SCIENTIFIC EXAMINATIONS.

Special Classes for these Examinations are held at St. Bartholomew's Hospital. The Classes are not confined to Students of the Hospital

A Class for the Matriculation Examination is held twice in each year, from October to January, and from March to June.

A Class for the Preliminary Scientific Examination is held from January to July.

For particulars, application may be made, personally or by letter, to the Warden of the College, St. Bartholomew's Hospital

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

Opening of WINTER SESSION, October 1st, 1874. Introductory Address by Mr EDMUND OWEN.

For further particulars apply to the Registrar at the Hospital, or to

A. B. SHEPHERD, M B , Dean of the School

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

THREE OPEN SCHOLARSHIPS and TWO EXHIBITIONS, October 1874.

For particulars apply to the Dean, St. Mary's Hospital, Paddington, W.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S. ; Dr. Frankland, F R.S. ; Dr. Roscoe, F R S. , Dr. Angus Smith, F.R.S. ; Dr. Tyndall, F R.S. ; Dr. Voelcker, F R S. ; Dr Williamson, F R.S.

C WILLMORE, Principal.

TWO COURSES of LECTURES on GEOLOGICAL MINERALOGY

will be given at King's College, London, by Professor TENNANT, to which the Public are admitted on paying the College Fees One Course is given on Wednesday and Friday Mornings, from Nine to Ten o'clock, commencing WEDNESDAY, October 7th, and terminating at Easter, 1875 The other Course is given on Thursday Evenings from Eight to Nine, commencing October 8th The Lectures are illustrated by a very extensive Collection of Specimens.

PRACTICAL INSTRUCTION in MINERALOGY and GEOLOGY is given by Professor TENNANT, F G.S , at his residence, 149, Strand, W.C.

KING'S COLLEGE, LONDON.

EVENING CLASS DEPARTMENT.

The following Courses of Lectures on PHYSICS and CHEMISTRY will commence on October 5th, and close towards the end of March.

Fee for each Course, £1 11s 6d

MECHANICS, HYDROSTATICS, and PNEUMATICS, Monday and Thursday, 6 to 7 p m —H. Tomlinson, B A.

LIGHT and SOUND, Wednesday, 7 to 8 p.m —Prof W. G. Adams, F.R S.

THEORETICAL CHEMISTRY, Monday and Thursday, 7 to 8 p.m.—W. N Hartley, F.C S.

The Laboratories will be open for

HEAT and ELECTRICITY, Prof. W. G. Adams, F R S , Friday, 7 to 8 30 p m — Fee, £3 3s.

ANALYTICAL CHEMISTRY, W. N. Hartley, F.C.S., Tuesday, 7 to 9 p m — Fee, £2 2s

KING'S COLLEGE.

GEOLOGY —EVENING CLASSES.

A Course of Thirty Lectures on GEOLOGY and PALÆONTOLOGY will be given by the Rev. THOS. WILTSHIRE, M A F G S , on Monday Evenings, commencing October 5. There will be, in addition, two or more Field Lectures in the neighbourhood of London on Saturday Afternoons in the Lent Term, and an Excursion of two or three days' duration at a distance from London in the Easter Term.

For additional information apply to the Secretary, King's College, Strand, London.

EVENING SCIENCE LECTURES.—

PHYSICAL GEOGRAPHY AND GEOLOGY.—Mr H FISHER, F G.S , will deliver, at the Birkbeck Institution, Southampton Buildings, Chancery Lane, a Course of Thirty Lectures on each of the above subjects, on THURSDAY EVENINGS at 7 and 8 o'clock respectively, commencing October 1st. Fee for the Two Courses, *7s. 6d.* ; a Single Course, *5s* —For further particulars apply to Secretary.

EVENING SCIENCE LECTURES.—Mr.

W. J WILSON, F.C S F P S. (Demonstrator of Practical Physics at South Kensington), will commence the following Courses of Lectures in the Theatre of the Birkbeck Institution, Southampton Buildings, W C , on October 1st and 2nd .—

Acoustics, Light, and Heat, 30 Lectures, on Thursdays, at 8 p m.
Electricity and Magnetism, 30 Lectures, on Fridays, at 8 p m.

Fee for one Course, *5s* , for the two, *7s 6d* For detailed Syllabus, particulars of Special Prizes, &c , apply to the Librarian.

At the Class Examinations of the Science and Art Department, May 1874, 130 Papers in Physics were worked by Mr Wilson's Pupils. Of these, 87 passed First Class and obtained Queen's Prizes , 41 passed Second Class, and two failed. In 1873, 68 Papers worked: 45 First Class, 23 Second Class, and *none failed*.

PRELIMINARY EXAMINATIONS of the

COLLEGE of SURGEONS and APOTHECARIES' HALL —Mr J ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c , address to 3, Pump Court, Temple, or to the care of Messrs Butterworth, 7, Fleet Street, her Majesty's Publishers.

THE LONDON HOSPITAL AND MEDICAL COLLEGE.

The next WINTER SESSION will commence on THURSDAY, Oct 1st, 1874, when the Introductory Lecture will be given at 3 p.m by SAMUEL FENWICK, M.D, Assistant Physician to the Hospital.

General Fee to Lectures, with two years' Practical Anatomy, and Hospital Practice, 90 guineas, payable in two instalments of 45 guineas each. Library Fee, £1 1s. Special entries can be made to Lectures or Practice.

The Hospital contains 600 beds. There are Medical and Surgical Wards for Children, Wards for Syphilis, Special Departments for Diseases of Women, Diseases of the Eye, Diseases of the Ear, Diseases of the Skin, and special arrangements for Diseases of the Throat. A Maternity Department exists for the delivery of lying-in women at their own homes. 586 cases were attended last year by the Students of the Hospital.

For instruction in Mental Diseases, Students can attend without further fee the practice of Dr. John Millar, Superintendent of Bethnal House Asylum, a few minutes' walk from the Hospital.

Clinical Lectures, both Medical and Surgical, will be given every week, and practical instructions imparted in all the departments.

The In-patients during 1873 were 5,613, and the Out-patients 43,808, total, 49,421.

At the Medical College, which has been enlarged, Lectures will be given on all the subjects required by the Examining Boards.

Members of the Staff and Lecturers at the College.

Mr. J. Luke, F.R.S.
Mr John Adams
Mr. Curling, F.R.S
Dr. Herbert Davies
Dr Andrew Clark
Dr. Ramskill
Dr. Langdon Down
Dr Hughlings-Jackson
Dr Sutton
Dr Fenwick
Dr. Woodman
Dr. Stephen Mackenzie
Dr. A. E. Sansom
Mr Jonathan Hutchinson
Mr Maunder
Mr. Couper
Mr. Walter Rivington
Mr Jas Adams
Mr Waren Tay
Mr. McCarthy
Mr. Reeves
Dr. Head
Dr. Palfrey
Mr H J Barrett
Mr A. W Barrett
Dr. Letheby
Dr. Meymott Tidy
Dr. Prosser James
Dr Morell-Mackenzie
Mr. J E D. Rogers
Mr. Gilbert Baker

The following Prizes and Appointments are open without any further payment to Students paying the general fee of 90 guineas:—

Seven Scholarships, to be offered for competition in the Winter Session:

1. A Scholarship of £30 to the Student of less than three months' standing who passes in October the best examination in the subjects required at the Preliminary Examination.
2. A Scholarship of £20 to the Student of less than three months' standing placed second in the above examination.
3. A Scholarship of £20 in Human Anatomy for first-year Students; to be awarded in April 1875
4. A Scholarship, value £25, in Anatomy, Physiology, and Chemistry, for first-year and second-year Students; to be awarded in April 1875.
5. A Hospital Scholarship, value £20, for Clinical Medicine; to be awarded in April 1875.
6. A Hospital Scholarship, value £20, for Clinical Surgery; to be awarded in April 1875.
7. A Hospital Scholarship, value £20, for Clinical Obstetrics, to be awarded in April 1875; and a Prize of £5 to the Student who has attended most Midwifery Cases for the Hospital during the preceding twelve months.

The Duckworth Nelson Prize, value £10, for Practical Medicine and Surgery (Biennial), 1875

Money Prizes to the value of £60 given annually by the House Committee for zeal in Dressing Out-patients and knowledge of Minor Surgery

Certificates of Honour in all the Classes according to the results of the General Examinations at the end of the Session, and Special Certificates to those who have filled with credit the duties of the Hospital Appointments.

Four House-Surgeoncies, tenable for three or six months, and Dresserships to In-patients, open to all.

Dresserships to Out-patients, with the privilege of competing for the Prizes above mentioned.

The office of the Resident Medical Officer, tenable for two years, with a salary of £75 the first year, and £100 the second year.

The Office of Junior Resident Medical Officer, tenable for six months

Four Medical Assistantships, held for three months, with residence and board in the Hospital for three weeks.

The office of Resident Accoucheur, tenable for six months.

N B.—The holders of all the resident offices are provided with rooms and board free of expense.

Four offices of Clinical Assistants in the Out-patients' Department, each at a salary of £40

The office of Medical Registrar, salary 25 guineas.

The office of Surgical Registrar, salary 35 guineas

Prosectors of Anatomy, Ward Clerks, and Post mortem Clerks.

A Prospectus, giving details, will be forwarded on application to the Bedell of the London Hospital Medical College, Turner Street, E.

Further information may also be obtained from Mr. James E. Adams, Treasurer, 10, Finsbury Circus, E.C., or Mr. Waren Tay, Vice-Dean, at the Medical College.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open to Pupils EVERY DAY and EVENING. The subjects of the above Exhibitions can be studied either Privately or in Classes. Fees moderate. Analyses and Investigations conducted.—Apply to Prof. E. V. GARDNER, F.E.S., F.S.A., 44, Berners Street, W.

MATRICULATION EXAMINATION, LOND. UNIV., January 1875.

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, READS WITH PUPILS for this Exam. He is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Exam., having passed fifty-seven Pupils, to whom reference can be given. Two of these passed in the Honours list in January 1873, seventh and fourteenth respectively. A Class will commence early in September, and another early in October. Fees for the two, £14 and £10 10s respectively. For further particulars, address 24, Old Square, Lincoln's Inn, W C.—A few Residents can be accommodated in Mr. Hanbury's house at Clapham

PRELIMINARY EXAMINATION IN ARTS, ROYAL COLL. SURG., December 1874.

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, PREPARES PUPILS for this Exam. He is assisted by efficient Lecturers in French and Chemistry, and has passed several Pupils for this Exam., to whom reference can be given. Terms from 8 to 12 Guineas, according to subjects taken up and time of joining the class. For further particulars, address, 24, Old Square, Lincoln's Inn, W.C.

TUITION in CLASSICS, ENGLISH LANGUAGE, HISTORY, and LITERATURE.—An experienced Tutor attends Schools and Families, in London or the Country, to teach the above Subjects. Prepares for the Public Schools, Universities, and the Army.—Address TUTOR, 15, Gledhow Terrace, South Kensington, S.W.

Mr. C. H. LAKE (Graduate in Honours, London) receives a limited number of RESIDENT PUPILS. Testimonials from the late J. S. Mill, Dr. Tyndall, &c. Science receives careful attention.—Witherndon, Caterham, Surrey.

MATHEMATICS and SCIENCE.—Pupils prepared for Competitive and Pass Examinations by a High Wrangler and Nat. Science Man. Successful in Tuition. In the Country by Correspondence. Classes visited.—J F BLAKE, 6, Wells Road, Regent's Park, N W.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c., of J TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S., at his residence, 149, Strand, W C.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 21s., 200 ditto, £2 10s. to £3 10s.; 300 ditto, £4 10s. to £6; 400 ditto, £6 to £8, 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples, £3 10s 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s.; 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6. RECENT SHELLS: 100 genera, £1, 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

To GEOLOGISTS.—GEOLOGICAL MAP of YORKSHIRE. By WM SMITH. Good condition. Scale, 4 miles to an inch. Price £5.—Apply to ALPHA, 31, Oakfield Road, Everton, Liverpool.

To SCIENTIFIC COLLECTORS and OTHERS.—A MEDICAL MAN retiring from practice has for disposal FOUR CASES, all of the best Spanish mahogany, French polished, with glass folding doors. Three, each 7 ft 6 in (in three heights) by 3 ft., with shelves for bottles, and one, 7 ft 6 in. (in two heights) by 6 ft 3 in, the upper height containing 300 small drawers, 3½ by 3 by 7 in, the lower part having shelves with large drawers. All the drawers are of oak, dovetailed, with Spanish mahogany fronts.—Apply at 14, Church Row, Limehouse.

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

Price 2s. 6d., free by post for 2s. 10d.

THE NEW QUARTERLY MAGAZINE

FOR OCTOBER.

CONTENTS.

"Travels in Portugal." (Concluded.) By John Latouche.
"The Fauna of Fancy." By Frances Power Cobbe.
"A Sea Changeling." A Novel. By the Author of "Olive Varcoe."
"Spiritualism in England." By Nathaniel A. Harness.
"The Character of Goethe." By Robert Buchanan, Author of "White Rose and Red."
"Small Farms." By Richard Jefferies.
"In the Rue Froide." A Tale. By Katharine S. Macquoid, Author of "Patty."

London: WARD, LOCK, & TYLER, Warwick House, Paternoster Row.

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences.

6d. MONTHLY, or POST-FREE, 6s. 6d. PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—

The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions.
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

*** This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

INTERNATIONAL CONGRESS OF ORIENTALISTS.

THE ACADEMY

Of SATURDAYS, Sept. 19 and Sept. 26, will contain Verbatim Reports of the Addresses of the President and of the Presidents of the various Sections; as well as Abstracts of all the more Important Communications made to the Congress. Price 4d.; free by post, 4½d.

W. G. SMITH, 43, Wellington Street, Strand, W.C.; and by order of all Booksellers and Newsmen.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations,
Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each, the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only Journal officially connected with brewing interests.

Subscription, 16s 6d. per annum, post free, dating from any quarter-day. Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, W.C.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,
Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

Price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & CO.

CHEMISTRY.

BLOXAM'S LABORATORY TEACHING; or, Progressive Exercises in Practical Chemistry. Third Edition, with 89 Engravings, crown 8vo, 5s. 6d.

BOWMAN and BLOXAM'S PRACTICAL CHEMISTRY, including Analysis. Sixth Edition, with 98 Engravings, fcap. 8vo, 6s. 6d.

CLOWES' (F.) PRACTICAL and ANALYTICAL CHEMISTRY, specially adapted for Schools and Colleges. With 46 Engravings, post 8vo, 7s. 6d.

FOWNES' MANUAL of CHEMISTRY. Edited by HENRY WATTS. Eleventh Edition, with 163 Engravings, crown 8vo, 15s.

VALENTIN'S INTRODUCTION TO INORGANIC CHEMISTRY. With 80 Engravings, 8vo, 6s. 6d.

VALENTIN'S COURSE of QUALITATIVE CHEMICAL ANALYSIS. Third Edition. With 19 Engravings, 8vo, 7s. 6d. [Just ready.

J. & A. CHURCHILL, New Burlington Street.

ZOOLOGY.

HUXLEY'S MANUAL of the ANATOMY of VERTEBRATED ANIMALS. With Engravings, fcap. 8vo, 12s.

HUXLEY'S INTRODUCTION to THE CLASSIFICATION of ANIMALS. With Engravings, 8vo, 6s.

ORD'S NOTES on COMPARATIVE ANATOMY: a Syllabus of a Course of Lectures delivered at St. Thomas's Hospital. Crown 8vo, 5s.

"Mr. Ord has been very successful in placing before the reader in a highly condensed form the principal facts of comparative anatomy"—*Lancet.*

GREENE'S TABLES of ZOOLOGY, indicating the Tribes, Sub-Orders, Orders, and Higher Groups of the Animal Kingdom, for Students, Lecturers, and others. Three Large Sheets, 5s., or on canvas, with roller, and varnished, 12s. 6d.

WILSON'S (A.) STUDENT'S GUIDE to ZOOLOGY: a Manual of the Principles of Zoological Science. With Engravings, fcap. 8vo, 6s. 6d.

"It is alike lucid and well arranged."—*Med. Times and Gazette.*
"Really a good book, well and clearly written."—*Edin. Med. Journal.*
"A trustworthy guide."—*Lancet.*
"The illustrations are clear, and the whole work is elegant and compact."—*Med.-Chir. Review.*

J. & A. CHURCHILL, New Burlington Street.

BOTANY.

BENTLEY'S MANUAL of BOTANY. Third Edition, Revised and Enlarged, with 1,138 Wood Engravings, crown 8vo, 14s.

*** The whole of the work has been very carefully revised throughout, and some parts rewritten and rearranged: and it is confidently hoped that it will, even better than the preceding editions, serve as a convenient, intelligible, and faithful as well as comprehensive manual for students.

"A model of careful, conscientious, clear, and exhaustive description."—*Brit. Med. Journal.*

J. & A. CHURCHILL, New Burlington Street.

PHYSICS.

RODWELL'S NOTES on NATURAL PHILOSOPHY. With 48 Wood Engravings, crown 8vo, 5s.

"We strongly recommend these 'Notes' to all who need the intellectual refreshment of a well-arranged and carefully-written condensation of the leading facts and principles of the chief elements of Natural Philosophy."—*Chemical News.*

"The author has carefully avoided that atrocious system of giving candidates only just such knowledge as may help them to scrape through an examination."—NATURE.

KOHLRAUSCH'S INTRODUCTION to PHYSICAL MEASUREMENTS. Translated from the Second German Edition by T. H. WALLER and H. R. PROCTER. With Engravings, 8vo, 12s.

J. & A. CHURCHILL, New Burlington Street.

Now ready, post-free on receipt of two penny stamps.

PRYDE'S CATALOGUE of MEDICAL and SCIENTIFIC WORKS, new and second-hand.—JOHN PRYDE, Medical Bookseller, 211, 213, and 215, Sauchiehall Street, Glasgow.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative 16 Plates, 10s. 6d. Now ready, Third Edition. J. & A. CHURCHILL.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d. J. & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12s. 6d. J. & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS Third Edition, 25s J. & A. CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s. 6d. J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition, much enlarged. J. & A. CHURCHILL. [In the Press.
7. HOW to WORK with the MICROSCOPE. 21s. HARRISON, Pall Mall.

Now ready, 8vo, 10s. 6d.

CLINICAL MEDICINE,

Lectures and Essays.

By BALTHAZAR FOSTER, M.D. F.R.C.P.,

Professor of Medicine in Queen's College, Physician to the General Hospital, Birmingham.

"The book may be taken up with advantage and profit, read with confidence as to its genuineness, and laid down with a feeling of admiration of the author's appreciation of clinical facts, and his facile and reasonable method of putting them."—*British Medical Journal.*

J. & A. CHURCHILL, New Burlington Street.

SCIENCE PRIMERS IN PREPARATION.

INTRODUCTORY. By Professor Huxley, F.R.S.

BOTANY. By J. D. Hooker, C.B. F.R.S., President of the Royal Society.

ASTRONOMY. By J. Norman Lockyer, F.R.S.

MACMILLAN & CO., LONDON.

Nearly ready, in 8vo, cloth.

INAUGURAL ADDRESS to the British Association for the Advancement of Science, at Belfast, August 19, 1874. By JOHN TYNDALL, President.

London: LONGMANS & CO.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

STONE IMPLEMENTS.—W. CUTTER has received instructions from an eminent Collector to offer for Sale a fine and extensive set of Danish War-hatchets, Knives, Chisels, Sword-handles, Balls, Hammers, &c. Some of these specimens are of rare types, and in the finest condition: may be viewed in the large Room, 35, Great Russell Street, from 10 to 4.

FINE COLLECTION of FOREIGN and BRITISH WOODS, consisting of 3,000 examples; about 2,000 are beautifully squared, others are large sections, stems, curious growths, Tree Ferns, &c. The whole form a Museum, and have taken a lifetime to accumulate. May be viewed from 10 till 4 in the large Room (which is always available for the display of Collections for sale)—W. CUTTER, Naturalists' Agent, 35, Great Russell Street, who is always ready to purchase or dispose of Minerals, Shells, Insects, &c. Human Skeletons, Skulls, &c., kept in stock.

DIARY OF SOCIETIES.

LONDON

FRIDAY, SEPTEMBER 25

QUEKETT MICROSCOPICAL CLUB, at 8.—On the Salivary Glands of the Cockroach. By T. Charters White, M.R.C.S.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determ[illegible] devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & Co.

OFFICE: BEDFORD STREET, STRAND, W.C.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10*s.* 6*d.*, sent for P.O. order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10*s.* 6*d.*, sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

TISLEY'S

PENDULUM APPARATUS,

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

W. LADD & CO.
SCIENTIFIC INSTRUMENT MANUFACTURERS
(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s.*, 21*s.*, 26*s.* 6*d.*, and 31*s.* 6*d.*
" Double " 31*s.* 6*d.*, 42*s.*, and 52*s.* 6*d.*
" Umbilical " 42*s.* and 52*s.* 6*d.*
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s.* 6*d.*, 7*s.* 6*d.*, 10*s.*, and 16*s.* each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

PURE AERATED WATERS.

ELLIS'S
RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. ELLIS & SON, Ruthin, North Wales.

LONDON AGENTS:—W. BEST & SONS, Henrietta Street, Cavendish Square.

NATURE.—Wanted clean Copies of Nos. 10, 13, and 116. NATURE Office, 29, Bedford Street, Strand, W.C.

"NATURE" SERIES.

A SERIES OF POPULAR SCIENTIFIC WORKS.

Vol. I.—The SPECTROSCOPE and its APPLICATIONS. By J. Norman Lockyer, F.R.S. With numerous Illustrations. Second Edition, crown 8vo, 3*s.* 6*d.*

"To any student who wishes to make himself, in a comparatively short time, well acquainted with the principles and the application of the spectroscope, we cannot recommend a better treatise."—*Westminster Review.*

Vol. II.—The ORIGIN and METAMORPHOSIS of INSECTS. By Sir John Lubbock, M.P. F.R.S. With numerous Illustrations. Second Edition, crown 8vo, 3*s.* 6*d.*

"We invite attention to the admirable manner in which the subject of insect metamorphosis is illustrated by excellent figures."—*Field.*

Vol. III.—The BIRTH of CHEMISTRY. By G. F. Rodwell, F.R.A.S. F.C.S., Science Master in Marlborough College. With numerous Illustrations. Crown 8vo, 3*s.* 6*d.*

Mr. Rodwell's work is the product of scholarly investigation. Chemists cannot fail to enjoy it, and those who are not chemists will be tempted to enter on the study of its mysteries."—*Chemist and Druggist.*

"A thoughtful, suggestive, and decidedly readable work."—*Quarterly Journal of Science.*

The TRANSIT of VENUS. By George Forbes, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With numerous Illustrations. Crown 8vo, 3*s.* 6*d.*

To be shortly published.

POLARISATION of LIGHT. By W. Spottiswoode, LL.D. F.R.S. With numerous Illustrations. Crown 8vo.

The COMMON FROG. By St. George Mivart, F.R.S., Lecturer on Comparative Anatomy at St. Mary's Hospital. With numerous Illustrations. Crown 8vo.

On BRITISH WILD FLOWERS, considered in RELATION to INSECTS. By Sir JOHN LUBBOCK, M.P. F.R.S. With numerous Illustrations. Crown 8vo.

MACMILLAN & CO., LONDON.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.

Pillischer's
St. Thomas's Hospital
Microscope,

As supplied to the principal Universities and Hospitals.
Monocular, £5; Binocular, £10 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to $\frac{1}{25}$ inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in, 14*s.*, 4½ in, 17*s*, 6 in, in Wooden Case, 10*s*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO:

88, New Bond Street, W., London.

HOLLOWAY'S PILLS and OINTMENT.—Deranged Stomach.—Sick Headache.—Our comfort, happiness, and security depend on the knowledge that most diseases originate by apparently a trifling beginning; and the large proportion of them spring from inattention to the state of the stomach. Professor Holloway has turned this knowledge to useful account by discovering medicines which rectify the error as soon as it is seen, and save the system from loss of appetite, strength, and energy, which are, without exception, the attendants on disordered digestion. They ward off likewise the torturing sick headache. The Ointment should be well rubbed twice daily over the stomach, liver, and bowels; to them it penetrates, and upon them it immediately exerts its renovating influence.

WORKS IN MEDICINE, &c.

Dr. McCall Anderson on the TREATMENT of DISEASES of the SKIN; with an Analysis of Eleven Thousand Consecutive Cases. Crown 8vo, 5*s*.

Dr. T. Clifford Allbutt on the USE of the OPHTHALMOSCOPE in DISEASES of the NERVOUS SYSTEM and of the KIDNEYS, also in certain other General Disorders. 8vo, 15*s*.

Dr. Wilson Fox on DISEASES of the STOMACH Being a Third and Revised Edition of the DIAGNOSIS and TREATMENT of the VARIETIES of DYSPEPSIA. 8vo, 8*s*. 6*d*.

Dr. Wilson Fox on the ARTIFICIAL PRODUCTION of TUBERCLE in the LOWER ANIMALS With Plates, 4to, 5*s* 6*d*.

Dr. Wilson Fox on the TREATMENT of HYPERPYREXIA as illustrated in Acute Articular Rheumatism by means of the External Application of Cold. 8vo, 2*s*. 6*d*

Professor Flower's INTRODUCTION to the OSTEOLOGY of the MAMMALIA Lectures at the Royal College of Surgeons. With Illustrations Globe 8vo, 7*s* 6*d*.

Dr. Wharton Hood on BONE-SETTING (so called) and its Relation to the Treatment of Joints crippled by Injury, Rheumatism, Inflammation, &c. Crown 8vo, 4*s* 6*d*.

Dr. H. Maudsley's BODY and MIND: an Inquiry into their Connection and Mutual Influence, specially in reference to Mental Disorders. New Edition, with Psychological Essays added Crown 8vo, 6*s* 6*d*.

Dr. J. Macpherson's OUR BATHS and WELLS. the Mineral Waters of the British Islands; with a List of Sea-bathing Places Fcap 8vo, 3*s*. 6*d*.

Dr. J. Macpherson's The BATHS and WELLS of EUROPE: their Action and Uses, with Notices of Climatic Resorts and Diet Cures New Edition, Revised and Enlarged. Extra fcap 8vo, 6*s* 6*d*.

Dr. E. C. Seaton's HANDBOOK of VACCINATION. Extra fcap. 8vo, 8*s* 6*d*.

MACMILLAN & CO., LONDON.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV From 10*s*. each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8*s*.; Ladies' Chest Expanders from 5*s*. 6*d*.—SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free SALMON ODY & CO. 292, Strand, London.

BRYANT&MAY'S
MATCHES.

Dr. Russell Reynolds' SYSTEM of MEDICINE. In 8vo, price 25*s* each.

- Vol. I.—GENERAL DISEASES: or, Affections of the Whole System. Second Edition.
- Vol. II.—DISEASES of the NERVOUS SYSTEM and of the STOMACH Second Edition
- Vol. III.—DISEASES of the DIGESTIVE SYSTEM (continued); Diseases of the Mouth; Diseases of the Respiratory System
- Vol. IV.—DISEASES of the CIRCULATORY SYSTEM, the Blood-Glandular, the Urinary, the Reproductive, and Cutaneous Systems. [*In preparation*

MACMILLAN & CO, London.

HEALTH FOR ALL.

PRESTON'S PURIFYING PILLS.—The BLOOD MEDICINE. Sold in boxes at 7½*d*., 1*s*. 1½*d*., and 2*s*. 9*d*. Sent free on receipt of 8, 14, or 33 stamps.

This fine BLOOD Medicine is warranted not to contain a single particle of MERCURY, or any other Mineral, but to consist entirely of Medicinal Balsams PURELY VEGETABLE. One trial will convince anyone of their efficacy in all diseases of the Head, Chest, Heart, Lungs, Kidneys, Liver, Bowels, and likewise in Skin Diseases. These Pills create new, rich, and pure blood, and expel all impurities. They give IMMEDIATE relief, and very quickly cure, as a single box will prove.

They strengthen the constitution, improve the health, and greatly prolong life.

There is considerable saving in buying the larger boxes, as a 2*s*. 9*d*. box contains 100 pills.

As a family medicine they are greatly to be preferred, as they do not act upon the bowels, and are not in the slightest degree opening.

Prepared only by THOMAS PRESTON, M.B., at the City Medical Hall, 84, Long Lane, Smithfield, London.

⁂ The Government Stamp is on every box.

LUNG HEALER,

FOR DISEASES OF THE CHEST, THROAT, AND LUNGS.

PRESTON'S LUNG HEALER is a fine Balsamic Elixir which acts direct upon the Lungs, giving immediate relief, and eventually a permanent and lasting cure, even in cases where everything else has been tried and failed.

LUNG HEALER quickly cures Coughs, Colds, Asthma, Tightness or Wheezing at the Chest, difficulty of Breathing, Hoarseness, Phlegm, Tickling of the Throat, Shortness of Breath, Incipient Decline, Numbness and Weakness of the Lungs, Pains in the Chest, and Wasting Influenza, Hectic Fever, Night Sweats, Decay of the Lungs, Tubercular Disease, Expectoration, Palpitation and all the symptoms of Impending Consumption.

LUNG HEALER strengthens the Lungs and thereby prevents Consumption. The Voice improves; Coughs and Colds are guarded against. It thoroughly eradicates hereditary consumptive taint if taken in time, and all who may be threatened with decline may rest in safety after a few doses of LUNG HEALER.

Sold in bottles at 2*s*. 9*d*. by THOMAS PRESTON, M.B, at the City Medical Hall, 84, Long Lane, Smithfield, London. The Government Stamp is on every bottle.

⁂ Order of any Chemist.

SECURITY FROM FIRE AND THIEVES.

CHATWOOD'S "INVINCIBLE" SAFES

CAN ONLY BE HAD IN LONDON, AT THE DEPÔT,

120, CANNON STREET, E.C.

Chatwood's "Invincible" Safe Depôt is situate near King William's Statue, at the corner of Cannon Street and King William Street. A Price List containing full details of the construction of these Safes is forwarded post-free on application to SCOTT AND LIDDELL, Sole Agents. The list is Net Cash, and for quality cannot be equalled, comprising, as they do, the list 2 quality with solid flange, lock case, and the frame, and the list 8 quality with intersected metal; curvilinear edge, claw bolts, and gunpowder-proof unpickable lock. The only secure and reliable Safes sold, and, as proof thereof, is the only Safe made subject to Thirty-six hours' test with any kind of burglars' appliances before delivery.

PRIZE MEDALS.

Paris, 1867. Havre, 1868. Dublin, 1865. Oporto, 1868. Vienna, 1873.

120, CANNON STREET, LONDON, E.C.

L. OERTLING,

TURNMILL STREET, NEAR FARRINGDON STREET STATION

(LATE OF 27, MOORGATE STREET, CITY),

MANUFACTURER OF

CHEMICAL, ASSAY, AND BULLION BALANCES.

Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c.

By Appointment.

Hydrometer and Saccharometer Maker to the Board of Inland Revenue.

Council Medal, 1851. *First Class Medal*, 1854 *and* 1862.

A FEW ARTIST'S PROOFS

OF THE

PORTRAIT of PROF. TYNDALL, F.R.S., D.C.L., LL.D.

(ENGRAVED ON STEEL BY CHAS. H. JEENS),

Have been printed on India Paper, and may be had at the Office of *NATURE*, 29, Bedford Street, Strand, W.C.

PRICE 5s. EACH,

OR THROUGH ANY BOOKSELLER.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s to 45s. Alberts, 2s to 5s ; Long Chains, 5s. to 8s. 6d.; Lockets, 2s to 5s 6d.; Crosses, 1s 6d. to 4s 6d., Ladies' Gem Rings, 2s. to 4s ; Wedding and Keeper Rings, 1s. to 2s 6d., Gents' Finger Rings, 2s 6d. to 6s.; Bracelets, 5s to 10s. 6d : Studs, 1s. to 3s 6d , Links, 1s to 3s , Breast Pins, 1s to 4s 6d , Brooches, 1s. 6d. to 7s 6d , Ear Rings, 1s 6d. to 6s 6d ; Sets (*en suite*), Brooch and Ear Rings, 5s 6d to 10s 6d , Pencil Cases, 2s to 4s 6d., Gents' Snake Rings (Plain Head), 3s 6d , Head set with Brilliant, &c , 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices, we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years. Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "**MAZELINE**" GOLD **JEWELLERY** to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P.O.O. to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & CO., at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, September 24, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

No. 257, Vol. 10] THURSDAY, OCTOBER 1, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office. [All Rights are Reserved

"NATURE,"

The Fourth Edition of Nature for August 20, containing a Steel Engraving of Professor Tyndall and his Inaugural Address at the Meeting of the British Association at Belfast, is now exhausted with the exception of a very few Copies, which may be had at the Office, price One Shilling each.

29, Bedford Street, Strand.

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

President—Lord F. C. Cavendish, M.P.

The FIRST SESSION will commence on MONDAY, October 26th, 1874, and terminate July 23rd, 1875.

CLASSES.

Mathematics—Professor A. W. Rücker, M A., Fellow of Brasenose College, Oxford Fee, £3 13s 6d per session.

Experimental Physics—Professor A. W. Rücker, M A. Fee, £2 12s. 6d. per session.

General Chemistry—Professor T E. Thorpe, Ph D. F.R.S E. F.C S Fee, £4 4s per session.

Chemical Laboratory—Professor T E. Thorpe, Ph D. Fee, from £4 4s. per month, whole session, £17 17s

Geology and Mining—Professor A Green, M.A. F.G.S., late Fellow of Gonville and Caius College, Cambridge. Fee, £4 4s per session.

Textile Industries—Professor William Walker (Endowed by the Cloth workers' Company, London). Fees: Course A, £10 10s; Course B, £5 5s

The arrangement for Evening Classes will be announced hereafter

Prospectuses of the Courses of Lectures are now ready, and may be had by written application to the Secretary.

J. D HEATON, Chairman.
Sept. 24, 1874 HENRY H. SALES, Secretary.

STATISTICAL SOCIETY.

NOTICE is Hereby Given, that the STATISTICAL SOCIETY has changed its quarters, and that from this date—the 20th September, 1874—its address is SOMERSET HOUSE TERRACE (King's College Entrance), STRAND, W.C., LONDON.

ST. MARY'S HOSPITAL MEDICAL SCHOOL.

THREE OPEN SCHOLARSHIPS and TWO EXHIBITIONS, October 1874.

For particulars apply to the Dean, St. Mary's Hospital, Paddington, W.

KING'S COLLEGE.

GEOLOGY.—EVENING CLASSES

A Course of Thirty Lectures on GEOLOGY and PALÆONTOLOGY will be given by the Rev. THOS WILTSHIRE, M A. F G S, on Monday Evenings, commencing October 5. There will be, in addition, two or more Field Lectures in the neighbourhood of London on Saturday Afternoons in the Lent Term, and an Excursion of two or three days' duration at a distance from London in the Easter Term.

For additional information apply to the Secretary, King's College, Strand, London.

LONDON LIBRARY,

12, ST. JAMES'S SQUARE.—Founded in 1841.

Patron—H.R.H. The Prince of Wales.

President—Thomas Carlyle, Esq.

This Library contains 90,000 Volumes of Ancient and Modern Literature, in various Languages Subscription, £3 a year, or £2 with Entrance Fee of £6; Life Membership, £26.

Fifteen Volumes are allowed to Country, and Ten to Town Members Reading Room open from Ten to half-past Six. Prospectus on application. Catalogue, New Edition, in the press.

ROBERT HARRISON, Secretary and Librarian.

TWO COURSES of LECTURES on GEOLOGICAL MINERALOGY

will be given at King's College, London, by Professor TENNANT, to which the Public are admitted on paying the College Fees. One Course is given on Wednesday and Friday Mornings, from Nine to Ten o'clock, commencing WEDNESDAY, October 7th, and terminating at Easter, 1875 The other Course is given on Thursday Evenings from Eight to Nine, commencing October 8th. The Lectures are illustrated by a very extensive Collection of Specimens.

PRACTICAL INSTRUCTION in MINERALOGY and GEOLOGY is given by Professor TENNANT, F.G S., at his residence, 149, Strand, W.C

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F R.S.; Dr. Roscoe, F R S; Dr Angus Smith, F.R.S., Dr. Tyndall, F.R.S.; Dr Voelcker, F R S., Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate Analyses and investigations conducted.—Apply to Prof. E. V. Gardner, F.E.S., F.S.A., 44, Berners Street, W.

MEDICAL EDUCATION of WOMEN.—

A MEDICAL SCHOOL for WOMEN will be Opened in London on October 12th.—All particulars can be obtained from the Secretary, Miss Heaton, 30, Henrietta Street, Brunswick Square, W C.

Mr. C. H. LAKE (Graduate in Honours,

London) receives a limited number of RESIDENT PUPILS. Testimonials from the late J. S. Mill, Dr Tyndall, &c. Science receives careful attention.—Witherndon, Caterham, Surrey.

MATRICULATION EXAMINATION, LOND. UNIV., January 1875

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, READS WITH PUPILS for this Exam. He is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Exam., having passed fifty-seven Pupils, to whom reference can be given. Two of these passed in the Honours list in January 1873, seventh and fourteenth respectively. A Class will commence early in September, and another early in October. Fees for the two, £14 and £10 10s. respectively. For further particulars, address 24, Old Square, Lincoln's Inn, W.C.—A few Residents can be accommodated in Mr. Hanbury's house at Clapham.

PRELIMINARY EXAMINATION IN ARTS, ROYAL COLL. SURG., December 1874.

F. A. HANBURY, M.A., Wrangler and late Senior Scholar of his College, PREPARES PUPILS for this Exam. He is assisted by efficient Lecturers in French and Chemistry, and has passed several Pupils for this Exam., to whom reference can be given. Terms from 8 to 12 Guineas, according to subjects taken up and time of joining the class. For further particulars, address 24, Old Square, Lincoln's Inn, W.C.

EVENING SCIENCE LECTURES.—Mr. W. J. WILSON, F.C.S., F.P.S. (Demonstrator of Practical Physics at South Kensington), will commence the following Courses of Lectures in the Theatre of the Birkbeck Institution, Southampton Buildings, W.C., on October 1st and 2nd:—

Acoustics, Light, and Heat, 30 Lectures, on Thursdays, at 8 p.m.
Electricity and Magnetism, 30 Lectures, on Fridays, at 8 p.m.

Fee for one Course, 5s.; for the two, 7s. 6d. For detailed Syllabus, particulars of Special Prizes, &c., apply to the Librarian.

At the Class Examinations of the Science and Art Department, May 1874, 130 Papers in Physics were worked by Mr. Wilson's Pupils, with the following results:—One Studentship in Physics at South Kensington, one Silver Medal, one Bronze Medal, 87 First Class Certificates with Queen's Prizes, 41 Second Class, two failed. In May 1873, 68 Papers worked: 45 First Class, 23 Second Class, and *none failed*.

MATHEMATICS and SCIENCE.—Pupils prepared for Competitive and Pass Examinations by a High Wrangler and Nat. Science Man. Successful in Tuition. In the Country by Correspondence. Classes visited.—J. F. BLAKE, 6, Wells Road, Regent's Park, N.W.

PRELIMINARY EXAMINATIONS of the COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr. J. ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations. For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c., address to 3, Pump Court, Temple, or to the care of Messrs. Butterworth, 7, Fleet Street, her Majesty's Publishers.

SCIENCE TUITION by CORRESPONDENCE.—For terms, apply to D. C. L., care of Macmillan and Co., 29, Bedford Street, Strand, London, W.C.

PRIVATE TUITION.—A Clergyman of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS. Home comforts combined with great educational advantages. The highest references.—M. A., care of Editor of NATURE, 29, Bedford Street, Strand, W.C.

MICROSCOPE by Smith and Beck for Sale, with Sub-stage, three Eye-pieces, best Objectives, and a quantity of expensive accessories. The whole in Mahogany Cabinet, and cost £50. To be sold for £28.—Apply by letter to R. B., care of Macmillan and Co., 29, Bedford Street, Covent Garden, W.C.

A LADY requires a RE-APPOINTMENT. German, French, the Elements of Natural Science, together with all the usual branches of Education. Highest references can be given.—Address, M. A. H., care of the Publishers of NATURE, 29, Bedford Street, Covent Garden, W.C.

MICROSCOPE for Sale, very Cheap. First-class Stand, with complete Mechanical Movements, A and C Eye-pieces, 1, ½, ¼ (adjusting) Objectives, &c. Upright Cabinet with drawers.—For price and other particulars apply by letter to J. B. D., care of the Publishers of NATURE.

SCIENTIFIC LECTURES.—A Gentleman who is a M.A., will be glad to make arrangements for Lecturing on Scientific Subjects to Schools, Institutes, &c.—Address for further particulars to S. E. P., care of Macmillan and Co., 29, Bedford Street, Strand, W.C.

SUNDEWS—DROSERA ROTUNDIFOLIA.—See NATURE for September 3, page 367. One Plant, 9d., or six strong in flower, or seed, 2s. 6d. Free by post.

A. W., Highampton, Devon.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c., of J. TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S., at his residence, 149, Strand, W.C.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 25s.; 200 ditto, £2 10s. to £3 10s.; 300 ditto, £4 10s. to £6; 400 ditto, £6 to £8; 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples, £3 10s. 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s.; 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6. RECENT SHELLS: 100 genera, £1, 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

STONE IMPLEMENTS.—W. CUTTER has received instructions from an eminent Collector to offer for Sale a fine and extensive set of Danish War-hatchets, Knives, Chisels, Sword-handles, Balls, Hammers, &c. Some of these specimens are of rare types, and in the finest condition: may be viewed in the large Room, 35, Great Russell Street, from 10 to 4.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

British Rocks—100 Specimens ... ... One Guinea.
British Fossils—100 " ... ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

NOTICE.—To Science Classes.—MOT-TERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

TUITION in CLASSICS, ENGLISH LAN-GUAGE, HISTORY, and LITERATURE.—An experienced Tutor attends Schools and Families, in London or the Country, to teach the above Subjects. Prepares for the Public Schools, Universities, and the Army.—Address TUTOR, 15, Gledhow Terrace, South Kensington, S.W.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils to prepare for the Universities and other examinations; and has now vacancies.

Price 2s. 6d., free by post for 2s. 10d.

THE NEW QUARTERLY MAGAZINE

FOR OCTOBER.

CONTENTS.

"Travels in Portugal" (Concluded.) By John Latouche.
"The Fauna of Fancy." By Frances Power Cobbe.
"A Sea Changeling." A Novel. By the Author of "Olive Varcoe"
"Spiritualism in England" By Nathaniel A Harness
"The Character of Goethe." By Robert Buchanan, Author of "White Rose and Red"
"Small Farms" By Richard Jefferies
"In the Rue Froide." A Tale. By Katharine S. Macquoid, Author of "Patty."

London: WARD, LOCK, & TYLER, Warwick House, Paternoster Row.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hall Court.

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences

6d. MONTHLY, or POST-FREE, 6s. 6d PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—

The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions.
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

⁂ This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

MACMILLAN'S MAGAZINE.

No. 180 FOR OCTOBER.

PRICE 1s

CONTENTS.

1.—"Joseph Priestley." By Professor Huxley, F.R.S
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XXII.—XXIV.
3.—"Scholars and Friars: a Chapter in the History of Ecclesiastical Strife." By George L B. Wildig.
4.—"On Mr. Swinburne's 'Bothwell.'"
5.—"Lady Duff Gordon." A short Memoir, by her Daughter.
6.—"The Fool of Five Forks." A Tale By Bret Harte
7.—"The Poor Whites of India. A Few Words regarding them." By Sir Alexander Arbuthnot, K C S.I
8.—"Prussia and the Vatican." II. The Relations between Church and State in Prussia up to 1840
"Note to Article on 'Dies Iræ.'"

MACMILLAN & CO., London

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M B, F.L.S, British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs Ranken and Co., Drury House, St Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s 6d. bound in cloth); also covers for the volume (price 1s.), and back numbers.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S, Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s 6d for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, W.C.

THE ZOOLOGIST:

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L S. F.Z S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES, AND WINE AND SPIRIT TRADES RECORD

The Official Organ of the Country Brewers' Society.
(Founded [illegible].)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests, Subscription, 16s 6d per annum, post free, dating from any quarter-day. Single Copies, 1s. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

Price 14s., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & C.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U S.A.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations,

Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N B.—Communications, &c., should be sent to the Editors at the above address.

AN ELEMENTARY TREATISE ON STEAM. By JOHN PERRY, B.E., Whitworth Scholar, F.C.S., late Lecturer on Physics at Clifton College. 4s. 6d.

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light. The numerous examples and exercises will prove useful in all Physics classes; whether the whole course is followed or not; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's Hill.

MACMILLAN & CO., LONDON.

Nearly ready.

CHRISTIAN PRAYER and GENERAL LAWS; BURNEY (Cambridge Philosophical, £100) PRIZE ESSAY. Also an Appendix examining the views of Messrs Robertson, Knight, Brooke, Tyndall, and Galton. By GEORGE J ROMANES, M.A. The Essay contains much original matter relating to the philosophy of Science.

MACMILLAN & CO., Cambridge.

BOOKS ON SCIENCE.

The GEOLOGY of the VALLEY of the THAMES. By JOHN PHILLIPS, M.A. F.R.S., Professor of Geology in the University of Oxford. With Coloured Map and numerous Illustrations. 8vo, 21s.

"It does not often fall to our lot to open a book devoted to Science, and to derive from it the large amount of pleasure, and at the same time of real instruction, which we have found in the pages of this volume."—*Athenæum.*

VESUVIUS. By John Phillips, M.A., F.R.S. With numerous Maps and Illustrations. Crown 8vo, 10s. 6d.

"Professor Phillips has undertaken to give an authentic history of Vesuvius from the days of Crassus to the end of 1868, and to explain the phenomena of the burning mountain according to the laws of a rigid induction. His plan has been successfully carried out, and has resulted in a work of high value."—*Pall Mall Gazette.*

DESCRIPTIVE ASTRONOMY. A Handbook for the General Reader, and also for practical Observatory work. With 224 Illustrations and numerous Tables By G F. CHAMBERS, F.R.A.S., Barrister-at-Law. Demy 8vo, cloth, 856 pp., price 21s.

CHEMISTRY FOR STUDENTS. By A W. WILLIAMSON, Phil. Doc. F.R.S., Professor of Chemistry, University College, London. New Edition, with Solutions. Extra fcap. 8vo, cloth, price 8s. 6d.

EXERCISES IN PRACTICAL CHEMISTRY. By A G. VERNON HARCOURT, M.A F R.S., Senior Student of Christ Church, and Lee's Reader in Chemistry; and H. G. MADAN, M.A., Fellow of Queen's College, Oxford. Series I., Qualitative Exercises. Second Edition. Crown 8vo, price 7s. 6d.

AN ELEMENTARY TREATISE ON HEAT. By BALFOUR STEWART, LL.D. F.R.S., Professor of Natural History in Owens College, Manchester. Ext. fcap 8vo, with numerous Woodcuts and Diagrams, 7s. 6d. New Edition, revised and enlarged.

"The publication of this manual is exceedingly well-timed; it includes within narrow limits the leading facts and principles of this younger-born of the Sciences, and for the mastery of the greater portion of the contents only requires ordinary intelligence on the part of the reader."—*Spectator.*

FORMS OF ANIMAL LIFE. Being Outlines of Zoological Classification based upon Anatomical Investigation, and illustrated by Descriptions and Specimens and of Figures. By G. ROLLESTON, M.D F.R.S., Linacre Professor of Physiology, Oxford. Demy 8vo, price 16s.

A TREATISE on ACOUSTICS. By W. J. DONKIN, F.R.S, Savilian Professor of Astronomy in the University of Oxford Crown 8vo, price 7s. 6d.

A SYSTEM OF PHYSICAL EDUCATION: Theoretical and Practical. With 346 Illustrations drawn by A. MACDONALD, of the Oxford School of Art. By ARCHIBALD MACLAREN, The Gymnasium, Oxford. Ext. fcap. 8vo, price 7s. 6d.

"The work before us is one which should be in the hands of every schoolmaster and schoolmistress. It is marked in every line by good sense, and is so clearly written that no one can mistake its rules."—*Lancet.*

ELEMENTS OF NATURAL PHILOSOPHY. By Sir W. THOMSON, LL.D. D C.L. F.R.S, Professor of Natural Philosophy, Glasgow; and P. G. TAIT, M.A., Professor of Natural Philosophy, Edinburgh. Part I., 8vo, 9s.

Oxford: Printed at the Clarendon Press, and Published by MACMILLAN & CO., London, Publishers to the University.

THE LONDON HOSPITAL AND MEDICAL COLLEGE.

The next WINTER SESSION will commence on THURSDAY, Oct. 1st, 1874, when the Introductory Lecture will be given at 3 p.m. by SAMUEL FENWICK, M.D., Assistant Physician to the Hospital.

General Fee to Lectures, with two years' Practical Anatomy, and Hospital Practice, 90 guineas, payable in two instalments of 45 guineas each. Library Fee, £1 1s. Special entries can be made to Lectures or Practice.

The Hospital contains 600 beds. There are Medical and Surgical Wards for Children, Wards for Syphilis, Special Departments for Diseases of Women, Diseases of the Eye, Diseases of the Ear, Diseases of the Skin, and special arrangements for Diseases of the Throat. A Maternity Department exists for the delivery of lying-in women at their own homes. 586 cases were attended last year by the Students of the Hospital.

For instruction in Mental Diseases, Students can attend without further fee the practice of Dr. John Millar, Superintendent of Bethnal House Asylum, a few minutes' walk from the Hospital.

Clinical Lectures, both Medical and Surgical, will be given every week, and practical instructions imparted in all the departments.

The In-patients during 1873 were 5,613, and the Out-patients 43,808; total, 49,421.

At the Medical College, which has been enlarged, Lectures will be given on all the subjects required by the Examining Boards.

Members of the Staff and Lecturers at the College.

Mr. J. Luke, F.R.S.
Mr. John Adams
Mr. Curling, F.R.S.
Dr. Herbert Davies
Dr. Andrew Clark
Dr. Ramskill
Dr. Langdon Down
Dr. Hughlings-Jackson
Dr. Sutton
Dr. Fenwick
Dr. Woodman
Dr. Stephen Mackenzie
Dr. A. E. Sansom
Mr Jonathan Hutchinson
Mr Maunder
Mr. Couper
Mr. Walter Rivington
Mr. Jas. Adams
Mr. Waren Tay
Mr. McCarthy
Mr. Reeves
Dr. Head
Dr. Palfrey
Mr. H. J. Barrett
Mr. A. W. Barrett
Dr. Letheby
Dr. Meymott Tidy
Dr. Prosser James
Dr. Morell-Mackenzie
Mr. J. E. D. Rogers
Mr. Gilbert Baker

The following Prizes and Appointments are open without any further payment to Students paying the general fee of 90 guineas:—

Seven Scholarships, to be offered for competition in the Winter Session:

1. A Scholarship of £30 to the Student of less than three months' standing who passes in October the best examination in the subjects required at the Preliminary Examination.
2. A Scholarship of £20 to the Student of less than three months' standing placed second in the above examination.
3. A Scholarship of £20 in Human Anatomy for first-year Students; to be awarded in April 1875
4. A Scholarship, value £25, in Anatomy, Physiology, and Chemistry, for first-year and second-year Students; to be awarded in April 1875.
5. A Hospital Scholarship, value £20, for Clinical Medicine; to be awarded in April 1875.
6. A Hospital Scholarship, value £20, for Clinical Surgery; to be awarded in April 1875.
7. A Hospital Scholarship, value £20, for Clinical Obstetrics, to be awarded in April 1875; and a Prize of £5 to the Student who has attended most Midwifery Cases for the Hospital during the preceding twelve months.

The Duckworth Nelson Prize, value £10, for Practical Medicine and Surgery (Biennial), 1875.

Money Prizes to the value of £60 given annually by the House Committee for zeal in Dressing Out-patients and knowledge of Minor Surgery

Certificates of Honour in all the Classes according to the results of the General Examinations at the end of the Session, and Special Certificates to those who have filled with credit the duties of the Hospital Appointments.

Four House-Surgeoncies, tenable for three or six months, and Dresserships to In-patients, open to all.

Dresserships to Out-patients, with the privilege of competing for the Prizes above mentioned.

The office of the Resident Medical Officer, tenable for two years, with a salary of £75 the first year, and £100 the second year.

The Office of Junior Resident Medical Officer, tenable or six months

Four Medical Assistantships, held for three months, with residence and board in the Hospital for three weeks.

The office of Resident Accoucheur, tenable for six months.

N B.—The holders of all the resident offices are provided with rooms and board free of expense.

Four offices of Clinical Assistants in the Out-patients' Department, each at a salary of £40.

The office of Medical Registrar, salary 25 guineas.

The office of Surgical Registrar, salary 35 guineas.

Prosectors of Anatomy, Ward Clerks, and Post-mortem Clerks.

A Prospectus, giving details, will be forwarded on application to the Bedell of the London Hospital Medical College, Turner Street, E.

Further information may also be obtained from Mr. James E Adams, Treasurer, 10, Finsbury Circus, E.C.; or Mr. Waren Tay, Vice-Dean, at the Medical College.

PURE AERATED WATERS.

ELLIS'S

RUTHIN WATERS,

Soda, Potass, Seltzer, Lemonade, Lithia, and for GOUT, Lithia and Potass.

CORKS BRANDED "R. ELLIS & SON, RUTHIN," and every Label bears their Trade Mark. Sold everywhere, and Wholesale of R. Ellis & Son, Ruthin, North Wales.

LONDON AGENTS:—W. Best & Sons, Henrietta Street, Cavendish Square.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK

DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.

Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

COCOA

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

HOLLOWAY'S OINTMENT.—Bad legs, wounds, ulcers, and all descriptions of sores, are cured by the proper and diligent use of these inestimable preparations. To attempt to cure a bad leg by plastering the edges of the wound together is folly, for should the skin unite, a baggy diseased condition remains underneath, to break out with tenfold fury in a few days. The only rational permanent treatment, as indicated by nature, is to reduce the inflammation in and about the wound, to soothe the neighbouring nerves, to cool the heated blood as it courses along its vessels, and to render its watery ichorous discharges consistent and healthy. Holloway's Pills should likewise be taken to purify the blood and expel the noxious humour from the system.

In crown 8vo, with 49 Diagrams, price 6s.

BRINKLEY'S ASTRONOMY, revised and partly rewritten, with Additional Chapters, and an Appendix of Questions for Examination. By JOHN WILLIAM STUBBS, D.D., Fellow and Tutor of Trinity College, Dublin; and FRANCIS BRUNNOW, Ph.D., Astronomer Royal of Ireland, and Professor of Astronomy in the University of Dublin. Second Edition, enlarged and improved.

London: LONGMANS & CO.

SCIENTIFIC WORKS BY THE REV. PROVOST LLOYD.

Now ready, in 8vo, price 10s. 6d. cloth.

A TREATISE on MAGNETISM, General and Terrestrial. By HUMPHREY LLOYD, D.D. D.C.L., Provost of Trinity College, Dublin, Professor of Natural Philosophy in the University.

By the same Author, Third Edition, price 10s. 6d.

The WAVE-THEORY of LIGHT.

London: LONGMANS & CO.

Nearly ready, in One Volume, crown 8vo, 20 Plates and numerous Woodcut Illustrations.

TRANSITS of VENUS: a Popular Account of Past and Coming Transits from the first observed by Horrocks, A.D. 1639, to the Transit of A.D. 2012. By RICHARD A. PROCTOR, B.A. &c., Author of "The Sun," "Other Worlds than Ours," "The Universe," &c.

London: LONGMANS & CO.

DR. TYNDALL'S ADDRESS.

Now ready, in 8vo, price 3s. cloth.

ADDRESS Delivered before the British Association at Belfast; with Additions and a Preface. By JOHN TYNDALL, F.R.S., President.

London: LONGMANS & CO.

Just published.

IMPORTANT EDUCATIONAL ANATOMICAL WORKS (Physiological and Artistic), prepared and published for the Department of Science and Art.

SEVEN LIFE-SIZED DIAGRAMS of the HUMAN BODY. By JOHN MARSHALL, F.R.S. F.R.C.S., Professor of Anatomy to the Royal Academy. Designed expressly for Artists and Art Schools.

ELEVEN LIFE-SIZED PHYSIOLOGICAL DIAGRAMS of the HUMAN BODY. By JOHN MARSHALL, F.R.S. F.R.C.S., Professor of Surgery to University College. An entirely new edition, revised and extended.

Price 12s. 6d. each Sheet, coloured on paper, 7 ft. 3 in. by 3 ft. 9 in.

NINE BOTANICAL DIAGRAMS for the USE of Lecturers, Schools, &c.

Price £2 the set.

Prospectus of the above Works on application.

London: ALFRED TARRANT, 11, Serle Street, W.C.; CHAPMAN & HALL, Piccadilly, and all Booksellers.

Dr. Russell Reynolds' SYSTEM of MEDICINE. In 8vo, price 25s each.

Vol. I.—GENERAL DISEASES: or, Affections of the Whole System. Second Edition.

Vol. II.—DISEASES of the NERVOUS SYSTEM and of the STOMACH. Second Edition.

Vol. III.—DISEASES of the DIGESTIVE SYSTEM (continued); Diseases of the Mouth; Diseases of the Respiratory System.

Vol. IV.—DISEASES of the CIRCULATORY SYSTEM, the Blood-Glandular, the Urinary, the Reproductive, and Cutaneous Systems. [*In preparation.*

MACMILLAN & CO., London.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative. 16 Plates, 10s. 6d. Now ready, Third Edition. J. & A. CHURCHILL.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d. J. & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12s. 6d. J. & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS. Third Edition, 25s. J. & A. CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s. 6d. J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition, much enlarged. J. & A. CHURCHILL. [In the Press.
7. HOW to WORK with the MICROSCOPE. 21s. HARRISON, Pall Mall.

WORKS IN MEDICINE, &c.

Dr. McCall Anderson on the TREATMENT of DISEASES of the SKIN; with an Analysis of Eleven Thousand Consecutive Cases. Crown 8vo, 5s.

Dr. T. Clifford Allbutt on the USE of the OPHTHALMOSCOPE in DISEASES of the NERVOUS SYSTEM and of the KIDNEYS; also in certain other General Disorders. 8vo, 15s.

Dr. Wilson Fox on DISEASES of the STOMACH. Being a Third and Revised Edition of the DIAGNOSIS and TREATMENT of the VARIETIES of DYSPEPSIA. 8vo, 8s. 6d.

Dr. Wilson Fox on the ARTIFICIAL PRODUCTION of TUBERCLE in the LOWER ANIMALS. With Plates, 4to, 5s. 6d.

Dr. Wilson Fox on the TREATMENT of HYPERPYREXIA as Illustrated in Acute Articular Rheumatism by means of the External Application of Cold. 8vo, 2s. 6d.

Professor Flower's INTRODUCTION to the OSTEOLOGY of the MAMMALIA. Lectures at the Royal College of Surgeons. With Illustrations. Globe 8vo, 7s. 6d.

Dr. Wharton Hood on BONE-SETTING (so called) and its Relation to the Treatment of Joints crippled by Injury, Rheumatism, Inflammation, &c. Crown 8vo, 4s. 6d.

Dr. H. Maudsley's BODY and MIND: an Inquiry into their Connection and Mutual Influence, specially in reference to Mental Disorders. New Edition, with Psychological Essays added. Crown 8vo, 6s. 6d.

Dr. J. Macpherson's OUR BATHS and WELLS: the Mineral Waters of the British Islands; with a List of Sea-bathing Places. Fcap. 8vo, 3s. 6d.

Dr. J. Macpherson's The BATHS and WELLS of EUROPE: their Action and Uses; with Notices of Climatic Resorts and Diet Cures. New Edition, Revised and Enlarged. Extra fcap 8vo, 6s. 6d.

Dr. E. C. Seaton's HANDBOOK of VACCINATION. Extra fcap. 8vo, 8s. 6d.

MACMILLAN & CO., LONDON.

SCIENCE PRIMERS IN PREPARATION.

INTRODUCTORY. By Professor Huxley, F.R.S.

BOTANY. By J. D. Hooker, C.B. F.R.S., President of the Royal Society.

ASTRONOMY. By J. Norman Lockyer, F.R.S.

MACMILLAN & CO., LONDON.

ZOOLOGICAL SOCIETY'S LATEST PUBLICATIONS.

"Proceedings of the Scientific Meetings of the Society for 1874."—Part III., containing the Papers read at the Scientific Meetings in May and June 1874. With 20 Plates, mostly coloured, 12s.; with Plates uncoloured, 3s.

NOTICE.

Commencing from January of the present year, the "Proceedings" will be issued in four Parts, as follows:—

Part I., containing Papers read in January and February, on June 1st.
" II., " " March and April, on August 1st.
" III., " " May and June, on October 1st.
" IV., " " November and December, on April 1st.

The price will be 12s. per Part for the Edition with coloured, and 3s. per Part for that with uncoloured Plates.

"Transactions of the Society," Vol. VII. Part IX., price 42s. (completing the volume), containing "Researches upon the Anatomy of the Pinnipedia." Part III. "Descriptive Anatomy of the Sea-Lion (*Otaria jubata*)," by James Murie, M.D. &c. Eight Plates.

These publications may be obtained at the Society's Office, 11, Hanover Square, W., at Messrs. LONGMANS, the Society's Publishers, Paternoster Row, E.C., or through any bookseller.

DIARY OF SOCIETIES.

LONDON

WEDNESDAY, OCTOBER 7.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Supplementary Remarks on the Appendicularia: Alfred Sanders.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & CO.

OFFICE: BEDFORD STREET, STRAND, W.C.

NATURE.—Wanted clean Copies of Nos. 10, 13, 116, and 203 with Portrait. NATURE Office, 29, Bedford Street, Strand, W.C.

TISLEY'S

PENDULUM APPARATUS,

	£	s.	d.
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on	12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free … per dozen	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3	0	7	6
Ditto traced on blackened Glass, for the Lantern … per slide	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution — £5 5 0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD, S.W.
(Three minutes' walk from South Kensington Museum).

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours.—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

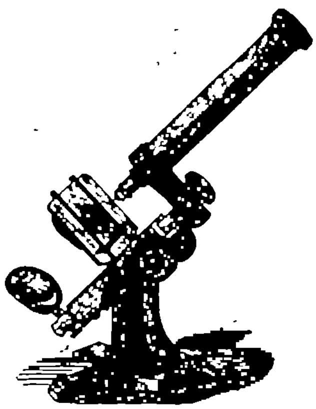
JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O. order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s 6d, sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.



INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,
London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,
OPTICIAN AND MANUFACTURER OF
ACHROMATIC MICROSCOPES,
AND ALL KINDS OF SCIENTIFIC INSTRUMENTS.

PILLISCHER'S ST. THOMAS'S HOSPITAL MICROSCOPE,
As supplied to the principal Universities and Hospitals. Monocular, 5*l.*; Binocular, 10*l.* 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/50 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in. 14*s.*; 4½ in. 17*s.*; 6 in., in Wooden Case, 10*s.*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO,
88, New Bond Street, W., London.

Now Ready. Price One Shilling.

ART
PICTORIAL AND INDUSTRIAL: A REVIEW.
FOR OCTOBER 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.
"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

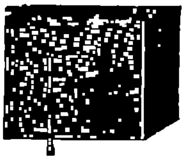
CONTENTS OF OCTOBER NUMBER.—Our Illustrations:—1. Gibson's "Venus," from the Original Study. 2. Fresco by Correggio. 3. "Hope," by Puvis De Chavannes.—Foley's Place among British Sculptors.—The Revised Theory of Light, by W. Cave Thomas, No. 2.—The Golden Wedding of Mr. and Mrs. S. C. Hall.—Art Notes and Gossip.—The Decoration of St. Paul's Cathedral (Letter No. 4.)

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

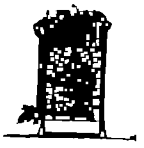
N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.
PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr. Lankester, September 30, 1867, Dr Letheby, February 15, 1865, and December 1872.
Price £1 10*s* and upwards Portable Filters on this system, £1 5*s.* to £3.
Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10*s.* 6*d.* and 21*s.* each.
Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.
Pocket Filters from 4*s.* 6*d* to 6*s.* each. Household and Fancy Filters from 12*s.* 6*d.*
The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.
Read "Water: its Impurities and Purification," price, per post, 2*d.*



House Cistern, fitted with a Cistern Filter.



Portable Cistern Filter.

NOW READY.
TECHNICAL TRAINING.
BY THOMAS TWINING,
ONE OF THE VICE-PRESIDENTS OF THE SOCIETY OF ARTS.
Being Suggestive Sketch of a National System of Industrial Instruction founded on a General Diffusion of Practical Science among the People. 8vo. 12*s.*
MACMILLAN & CO., LONDON.

E. DENT & CO., 61, Strand, & 34, Royal Exchange
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

"MAZELINE" GOLD JEWELLERY.
(*Catalogue post free.*)
18c. GOLD —Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD —Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)
"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c. gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s. to 45s. Alberts, 2s to 5s ; Long Chains, 5s to 8s. 6d. ; Lockets, 2s to 5s 6d , Crosses, 1s. 6d. to 4s. 6d ; Ladies' Gem Rings, 2s. to 5s ; Wedding and Keeper Rings, 1s. to 2s. 6d ; Gents' Finger Rings, 2s. 6d. to 6s. ; Bracelets, 5s to 10s. 6d : Studs, 1s. to 3s 6d ; Links, 1s. to 3s , Breast Pins, 1s. to 4s 6d , Brooches, 1s 6d. to 7s. 6d , Ear Rings, 1s. 6d to 6s. 6d : Sets (*en suite*), Brooch and Ear Rings, 5s 6d to 10s 6d. , Pencil Cases, 2s to 4s 6d , Gents' Snake Rings (Plain Head), 3s. 6d , Head set with Brilliant, &c , 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

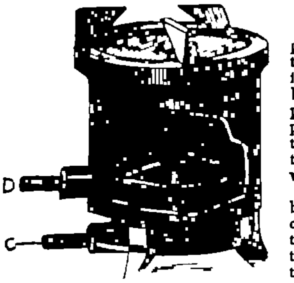
CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices ; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "MAZELINE" GOLD JEWELLERY to be obtained of
MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.
P O O to be made payable at Post Office, Bishopsgate Street Without, London, E C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

1871—FIRST-CLASS BRONZE MEDAL, Royal Cornwall Polytechnic Society. 1872.—SILVER MEDAL. 1873—INTERNATIONAL EXHIBITION PRIZE MEDAL.

FLETCHER'S
NEW LOW TEMPERATURE BURNER (PATENT)



This Burner gives a range of heating power from a gentle current of WARM air to a BRIGHT RED HEAT, and is so perfectly under control that a common glass bottle may be placed on the tripod without protection and heated to any required temperature without the slightest risk of fracture. In practical use it dispenses with the necessity for drying-closets, sand-and-water baths, &c

For very low temperatures the ring must be lighted through the opening B, this causes a current of warm air to rise through the gauze above. For higher temperatures the light must be applied on the surface of the gauze A, which will give a large body of clear blue flame. A special pattern is made with a blast tube, by which the flame on the surface can be concentrated and urged until it gives almost a clear white heat, the temperature depending on the air supplied through the blast tube

Price, without blast tube 7s. 6d
,, with blast tube for high temperatures ... 9s. 0d.

UNIVERSAL FURNACE (GAS),
For High Temperatures (without blast) for Crucibles, Muffles, &c , in several sizes and patterns Special designs made to order.

NEW BUNSEN BURNERS, giving a range of temperature up to a clear white heat, 10s. 6d.

HOT BLAST BLOWPIPES, giving temperatures exceeding the fusing-point of platinum, 11s 6d , 13s., 15s.

POWERFUL FOOT-BLOWERS, 18s.

Drawings and description from dealers in Chemical Apparatus, or from
THOMAS FLETCHER, F.C.S.,
13 & 15, SUEZ STREET,
WARRINGTON.

RUPTURES.—BY ROYAL LETTERS PATENT.
WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided ; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
,, Double ,, 31s. 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s. and 52s. 6d.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,
&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

BRYANT & MAY'S
MATCHES.

FORTHCOMING BOOKS.

BY SIR SAMUEL W. BAKER, PASHA, F.R.S., ETC.

Ismailia: a Narrative of the Expedition to Central Africa for the Suppression of the Slave Trade, organised by ISMAIL, KHEDIVE OF EGYPT. With Maps, Portraits, and upwards of Fifty full-page Illustrations by ZWECKER and DURAND. Two vols. 8vo.

The Russian Power. By Ashton W. Dilke. With Maps and Illustrations. Two vols. Medium 8vo.

Biography of the Right Hon. Francis BLACKBURNE, late Lord Chancellor of Ireland. Chiefly in Relation to his Public and Political Career. By his SON. 8vo.

Lady Duff Gordon's Last Letters from Egypt, to which are added Letters from the Cape. With a Memoir by her DAUGHTER. With Portrait engraved by JEENS after PHILLIPS. Crown 8vo.

A Ramble Round the World, 1871. *By* M. LE BARON DE HUBNER, formerly Ambassador and Minister. Translated by Lady HERBERT. Two vols. 8vo.

Cave Hunting; Researches on the Evidence of Caves respecting the Early Inhabitants of Europe. By W. BOYD DAWKINS, M.A., F.R.S., &c., Curator of the Museum, and Lecturer in Geology in the Owens College, Manchester. With Coloured Plate and Woodcuts. 8vo.

Milton's Poetical Works. Edited with Text Collated from the best Authorities, with Introduction and Notes. By DAVID MASSON, Professor of Rhetoric and English Literature in the University of Edinburgh. With Three Portraits engraved by C. H. JEENS and RADCLIFFE. Three vols. 8vo. (Uniform with the Cambridge Shakespeare.)

Milton's Poetical Works (Golden Treasury Edition). With Introduction and Notes, by Professor MASSON. With Two Portraits engraved by JEENS. Two vols. 18mo.

Michael Angelo Buonarroti: Sculptor, Painter, Architect. The Story of his Life and Labours. By CHARLES CHRISTOPHER BLACK, M.A. Illustrated with Twenty Woodbury Types. Medium 8vo, cloth extra, gilt.

History of the English People. By the Rev. J. R. GREEN, M.A. With Coloured Maps, Genealogical and Chronological Tables. Crown 8vo.

Michelet's Modern History. Translated from the French. With Continuation to the Present Time. By M. C. M. SIMPSON. Crown 8vo.

Scandinavian History. By E. C. Otté. With Maps. Globe 8vo.

Shakespeare's Plutarch. Being a Selection from the Lives in North's Plutarch which Illustrate Shakespeare's Plays. Edited with Introduction, Notes, and Glossarial Index. By the Rev. W. W. SKEAT, M.A. Crown 8vo.

A Theory about Sin in Relation to some Facts of Daily Life. Lent Lectures on the Seven Deadly Sins. By the Rev. ORBY SHIPLEY, M.A. Crown 8vo.

Catholic Reform. By Father Hyacinthe. Letters, Fragments, and Discourses. Translated by MDME. HYACINTHE LOYSON. With a Preface by the Very Rev. A. P. STANLEY, D.D., Dean of Westminster. Crown 8vo.

The Imitation of Christ. By Thomas Kempis. Translated with Preface by W. BENHAM, D.D., Vicar of Margate. Printed with Borders in the Ancient Style after Holbein, Durer, and other Old Masters, containing Dances of Death, Acts of Mercy, Emblems, &c., and a Variety of Curious Ornamentation. Crown 8vo.

Chatterton: a Story of the Year 1770. By Prof. MASSON, LL.D. Crown 8vo.

The Three Devils: Luther's, Milton's, and Goethe's; and other Essays. By Prof. MASSON, LL.D. Crown 8vo.

Induced Diseases of Modern Life. By BENJAMIN WARD RICHARDSON, M.D., F.R.S. Crown 8vo.

Outlines of Cosmic Philosophy, based on the Doctrine of Evolution, with Criticisms on the Positive Philosophy. By JOHN FISKE, M.A., LL.B., formerly Lecturer on Philosophy at Harvard University. Two Vols. 8vo.

The Evolution Hypothesis and the Origin of Life. By H. CHARLTON BASTIAN, M.D., F.R.S. Crown 8vo.

Pharmacographia. A History of the Principal Drugs of Vegetable Origin, found in Commerce in Great Britain and British India. By F. A. FLUCKIGER and D. HANBURY, F.R.S. 8vo.

The Elements of the Psychology of Cognition. By ROBERT JARDINE, B.D., D. Sc., Principal of the General Assembly's College, Calcutta. Crown 8vo.

Laocoon. Translated from the Text of LESSING, with Notes by the Right Hon. Sir ROBERT J. PHILLIMORE, D.C.L., Judge of the High Court of Admiralty, &c. 8vo.

The Extant Odes of Pindar. Translated into English, with an Introduction and Short Notes by ERNEST MYERS, M.A., Fellow of Wadham College, Oxford. Crown 8vo.

Social Life in Greece, from Homer to Menander. By the Rev. J. P. MAHAFFY, M.A., Fellow of Trinity College, Dublin. Crown 8vo.

Second Series of the Rev. T. Binney's Sermons, preached in the King's Weigh-house Chapel, London, 1829—1869. With Memoir by the Rev. HENRY ALLON, D.D. 8vo.

MACMILLAN & CO., LONDON.

FORTHCOMING BOOKS.

Our Sketching Club. Letters and Studies on Landscape Art. By the Rev. R. St. JOHN TYRWHITT, M.A. With an Authorised Reproduction of the Lessons and Woodcuts in Prof. Ruskin's "Elements of Drawing." Crown 8vo.

The Maid of Killeena, and other Stories. By WILLIAM BLACK, Author of "A Princess of Thule," &c. Crown 8vo.

The Harbour Bar. A Tale of Scottish Life. Two Vols. Crown 8vo.

Speaking Likenesses. By Christina Rossetti. With Illustrations By ARTHUR HUGHES. Crown 8vo.

*For the King's Dues. By Agnes Mac*DONNELL, Author of "Martin's Vineyard." Crown 8vo.

Govinda Samanta; or, the History of a Bengal Raiyat. By the Rev. LAL BEHARI DAY. Two vols. Crown 8vo.

The Princess of Silverland, and other Tales. By ELSIE STRYVELINE. With Frontispiece by Sir NOEL PATON. Globe 8vo. gilt.

The Common Frog. By St. George Mivart, F.R.S., &c. Lecturer on Comparative Anatomy at St. Mary's Hospital. With numerous Illustrations. (NATURE SERIES.)

Polarisation of Light. By W. Spottiswoode, LL.D., F.R.S. With numerous Illustrations. Crown 8vo. (NATURE SERIES.)

On British Wild Flowers considered in relation to Insects. By Sir JOHN LUBBOCK, M.P., F.R.S. Crown 8vo. (NATURE SERIES.)

Primer of Astronomy. By J. Norman LOCKYER, F.R.S. With Illustrations. 18mo. (MACMILLAN'S SCIENCE PRIMERS.)

Essays on Shakespeare. By Karle Elze, Ph.D. Translated, with permission of the Author, by L. DORA SCHMITZ.

A History of the English Drama. By A. W. WARD, M.A., Professor of History in Owens College, College, Manchester. Two vols. 8vo.

Third and Cheaper Edition. In One Vol. Medium 8vo. extra gilt,

*Holland House. By Princess Marie Liech*TENSTEIN. With Five Steel Engravings by C. H. JEENS, after Paintings by WATTS and other celebrated Artists, and numerous Illustrations drawn by Professor DELAMOTTE, and Engraved on Wood by J. D. COOPER and others. New and Cheaper Edition. In one vol. Crown 8vo.

Tales of Old Japan. By A. B. Mitford, late Second Secretary to the British Legation in Japan. With Illustrations, drawn and cut on Wood by Japanese Artists.

New and Cheaper Edition. Two Vols. Crown 8vo. 12s.

*Henry Crabb Robinson's Diary, Reminis*cences, and Correspondence. Selected and edited by Dr. SADLER. With Portrait.

Third Edition. Crown 8vo.

The Victory of Faith. By Julius Charles HARE, M.A., Archdeacon of Lewis. Edited by Professor PLUMTRE, with Introductory Notices by the late Professor MAURICE and Dean STANLEY.

New and Cheaper Edition. In One Vol. 8vo.

History of Ancient Philosophy. By the Rev. W. ARCHER BUTLER, late Professor of Moral Philosophy in the University of Dublin. Edited by W. HEPWORTH THOMPSON, D.D., Master of Trinity College, Cambridge. (Revised by the Editor).

New and Cheaper Edition. In One Vol. Crown 8vo.

Christ and Other Masters. A Historical Inquiry into some of the Chief Parallelisms and Contrasts between Christianity and the Religious Systems of the Ancient World. By the Ven. Archdeacon HARDWICK. Edited with Memoir by the Rev. F. PROCTER, M.A.

Cheaper Edition. Crown 8vo. 6s.

A Companion to the Lectionary. Being a Commentary on the Proper Lessons for Sundays and Holy Days. By the Rev. W. BENHAM, B.D., Vicar of Margate.

New Edition. With Additional Illustrations. Crown 8vo. 6s

Tom Brown's School Days. By an Old Boy. With Illustrations by ARTHUR HUGHES and SYDNEY PRIOR HALL.

Cheaper Issue. Crown 4to. 3s. 6d.

Ridicula Rediviva. Old Nursery Rhymes. Illustrated in Colours by J. E. ROGERS.

Cheaper Issue. Crown 4to. 3s. 6d.

Mores Ridiculi. Old Nursery Rhymes. Illustrated in Colours by J. E. ROGERS.

History of the Life-boat and its Work. By RICHARD LEWIS, of the Inner Temple, Barrister-at-Law. With Illustrations. Crown 8vo.

MACMILLAN AND CO., LONDON.

IMPORTANT CORRESPONDENCE.

THE REV. SIR EDWARD R. JODRELL, BART.,

To Messrs. FELTOE AND SONS, 26, Conduit Street, Bond Street, W.

When at Sall I received an Analytical Report of your "Specialité" Sherry, and you must forgive me for saying that at first I regarded the whole matter as a most egregious piece of humbug. Having, however, tasted the Wine in question, and found it most agreeable to the palate, I determined on my own responsibility to have it analysed *for myself*, having fully also determined previously to expose any hoax "pro bono publico," or to give you the benefit of the analysis, should it turn out in your favour. I have the pleasure to forward you Professor Redwood's (of the Pharmaceutical Society of Great Britain) Analysis, which says more than I can express. I am very particular as to the Wine I drink, and as I have been hitherto buying "every-day Sherry" at 60s a dozen, I am rejoiced to find *now* that I can purchase Wine of equal strength and superior bouquet at half that price. This should be known to the "General Public," and you can make any use you deem proper of this letter, and also of Professor Redwood's most elaborate analysis.

Yours faithfully,

21, Portland Place, London, December 9th, 1873. (*Signed*) EDWARD REPPS JODRELL.

THE REV. SIR E. R JODRELL.

SIR,—I have completed the Analysis of the sample of Sherry you left with me, and proceed to report the results. Judged by the palate it might be represented as a light, moderately dry Wine, with nothing to object to in its flavour or apparent strength.

I proceeded to make a more minute analysis, the results of which were as follows.—

Absolute Alcohol, by Volume	20·0 parts in 100
Free or unneutralised Acid, partly volatile and partly non-volatile	0·54 "
Volatile Acid (acetic acid)	0·1 "
Sugar and Extract	2·5 "
Ash, from incineration of Extract	0·45 "
MINERAL ACID, or inorganic matter, NOT YIELDED BY GRAPE-JUICE	NONE.

THESE RESULTS ARE ALL SATISFACTORY. The proportion of alcohol is that found in the best samples of Sherry; the volatile acid (acetic acid) is not more than is usually present, and the fixed acid is the TRUE ACID OF THE GRAPE, namely, tartaric acid. The ash is not more than it should be, and contains nothing foreign to the grape.

In preparing this Analysis, I have been enabled to observe that the alcohol, when separated from the other constituents of the wine, was PURE IN FLAVOUR AND OF GOOD QUALITY, and that there was NOTHING OBJECTIONABLE in the extract or other products that were separated in the process of analysation.

I am yours truly,

(*Signed*) T. REDWOOD, *Professor of Chemistry to the*
5th December, 1873 PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

The recent Medical Correspondence in the "TIMES" demonstrates how injurious to health is "made-up Sherry," ALCOHOLISED to an UNREASONABLE extent.

MESSRS. FELTOE AND SONS,

By appointment to the ROYAL FAMILY—established FIFTY-NINE years—are SOLE PROPRIETORS and IMPORTERS of the

"SPECIALITÉ" SHERRY,

Adopted and Recommended by nearly 2,000 Physicians and Surgeons for its Valuable Dietetic Qualities.

"To the meal of a patient suffering from Dyspepsia it would be valuable."
Medical Times.

"Free from Acidity and Heat,"
The British Medical Journal.

"Valuable for Gouty or Uric Acid tendencies."
Dr. Hardwicke, Metropolitan Analyst.

"Has a great Medical Reputation."
Medical Record.

"Contains nothing Foreign to the Grape."
Professor Redwood.

"THE CASH SYSTEM ONLY."

30s.. DOZEN. **£18** QUARTER CASK, of Bright Wine in Cask. Carriage paid to any Railway Station in England, and Scotland, and to any Port in Ireland.

MANZANILLA AND MONTILLA,

For the PURITY of which Wines Messrs. FELTOE & SONS are so renowned, are now also supplied at the same strictly CASH PRICE as their popular SPECIALITÉ SHERRY.

26, CONDUIT STREET, LONDON; MANCHESTER AND BRIGHTON.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co., at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, October 1, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 258, Vol. 10] THURSDAY, OCTOBER 8, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office [All Rights are Reserved

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

President—Lord F. C. Cavendish, M.P.

The FIRST SESSION will commence on MONDAY, October 26th, 1874, and terminate July 23rd, 1875

CLASSES.

Mathematics—Professor A W. Rücker, M.A., Fellow of Brasenose College, Oxford Fee, £3 13s 6d. per session.

Experimental Physics—Professor A. W. Rücker, M A. Fee, £2 12s. 6d. per session.

General Chemistry—Professor T. E. Thorpe, Ph D. F R.S.E. F.C.S. Fee, £4 4s per session.

Chemical Laboratory—Professor T. E. Thorpe, Ph D. Fee, from £4 4s. per month ; whole session, £17 17s.

Geology and Mining—Professor A Green, M A. F G.S , late Fellow of Gonville and Caius College, Cambridge. Fee, £4 4s per session.

Textile Industries—Professor William Walker (Endowed by the Clothworkers' Company, London) Fees : Course A, £10 10s , Course B, £5 5s.

The arrangement for Evening Classes will be announced hereafter

Prospectuses of the Courses of Lectures are now ready, and may be had by written application to the Secretary.

J. D. HEATON, Chairman.
Sept. 24, 1874. HENRY H. SALES, Secretary,

LONDON SCHOOL of MEDICINE FOR WOMEN,

30, Henrietta Street, Brunswick Square, W.C.

Council—Dr Charlton Bastian, Dr. Billing, Dr Elizabeth Blackwell, Dr. King Chambers, Dr Cheadle, Mr George Cowell, Mr. Critchett, Mrs. Garrett Anderson M D , Mr. Ernest Hart, Mr. Berkeley Hill Professor Huxley, Dr Hughlings Jackson, Dr Murie, Mr A T. Norton, Dr Payne, Dr W. S Playfair, Dr Burdon-Sanderson, Dr Sturges

Lecturers—Mr A W. Bennett, Dr King Chambers, Dr. Cheadle, Mr Critchett, Mrs Garrett Anderson, M D , Mr. Heaton, Mr. Berkeley Hill, Dr. Murie, Mr. A. T. Norton, Mr Schäfer, Dr. Sturges.

Dean of the School—Mr. A. T. Norton, vice Dr. Anstie, deceased.

The WINTER SESSION of 1874–75 will open on OCTOBER 12th and will comprise Classes in Anatomy, Practical Anatomy, Physiology, and Chemistry

For further particulars apply to the Dean of the School.

EMMA HEATON, Secretary

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical

References to Dr. Debus, F.R.S. ; Dr. Frankland, F R S. ; Dr. Roscoe, F.R S , Dr. Angus Smith, F.R.S. ; Dr. Tyndall, F.R.S ; Dr Voelcker, F R S. ; Dr. Williamson, F R.S.

C WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—

The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted —Apply to Prof. E. V. Gardner, F.E.S., F.S.A., 44, Berners Street, W.

"NATURE."

The Fourth Edition of Nature for August 20, containing a Steel Engraving of Professor Tyndall and his Inaugural Address at the Meeting of the British Association at Belfast, is now exhausted with the exception of a very few Copies, which may be had at the Office, price One Shilling each.

29, Bedford Street, Strand.

MATRICULATION EXAMINATION, LOND. UNIV., January 1875.

F. A. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, READS WITH PUPILS for this Exam. He is assisted by efficient Lecturers in French, Chemistry, and Classics, and has been particularly successful for this Exam , having passed fifty-seven Pupils, to whom reference can be given. Two of these passed in the Honours list in January 1873, seventh and fourteenth respectively. A Class will commence early in September, and another early in October. Fees for the two, £14 and £10 10s respectively For further particulars, address 24, Old Square, Lincoln's Inn, W C —A few Residents can be accommodated in Mr. Hanbury's house at Clapham.

PRELIMINARY EXAMINATION IN ARTS, ROYAL COLL. SURG , December 1874.

F. A. HANBURY, M.A., Wrangler and late

Senior Scholar of his College, PREPARES PUPILS for this Exam He is assisted by efficient Lecturers in French and Chemistry, and has passed several Pupils for this Exam , to whom reference can be given. Terms from 8 to 12 Guineas, according to subjects taken up and time of joining the class. For further particulars, address, 24, Old Square, Lincoln's Inn, W C.

PRELIMINARY EXAMINATIONS of the

COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr J. ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c., address to 3, Pump Court, Temple, or to the care of Messrs. Butterworth, 7, Fleet Street, her Majesty's Publishers.

LADIES' EDUCATIONAL ASSOCIA-

TION, in connection with University College, London.—Prof MORLEY and Prof BUND'S Evening Classes for Ladies, of English and English History, will open, at University College, respectively, on MONDAY, Oct. 12, at 6, and WEDNESDAY, Oct 21, at 5 30. The Day Classes will meet on MONDAY, Oct. 26 Prospectuses to be had in the Office at the College, or of J. E. Mylne, Esq., 27, Oxford Square, Hyde Park, W

MATHEMATICS and SCIENCE.—Pupils

prepared for Competitive and Pass Examinations by a High Wrangler and Nat. Science Man Successful in Tuition. In the Country by Correspondence Classes visited —J. F. Blake, 6, Wells Road, Regent's Park, N.W.

Mr. C. H. LAKE (Graduate in Honours,

London) receives a limited number of RESIDENT PUPILS. Testimonials from the late J. S Mill, Dr. Tyndall, &c. Science receives careful attention.—Withernden, Caterham, Surrey.

To PUBLISHERS, Journalists, Barristers, &c.—A Gentleman, long connected with the Press, well educated, a swift Shorthand Writer, and knowing French, seeks ENGAGEMENT as WRITER, TRANSLATOR, Literary Amanuensis, Secretary, or in any respectable capacity. Moderate Terms.—Address C R, Deacon's, Leadenhall Street; or R. F. O'Connor, 321, Vauxhall Bridge Road, S.W.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 21s.; 200 ditto, £2 10s. to £3 10s.; 300 ditto, £4 10s. to £6; 400 ditto, £6 to £8; 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples, £3 10s. 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s.; 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6. RECENT SHELLS: 100 genera, £1; 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c., of J. TENNANT, Mineralogist to Her Majesty 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S., at his residence, 149, Strand, W.C.

GEOLOGY.—Collections of Characteristic Fossils and Rocks for Students preparing for the Examinations, at moderate prices; also Single Specimens, Hammers, Pocket Lenses, Books, and all necessaries, of JAMES R. GREGORY, Geologist, 15, Russell Street, Covent Garden, W.C. Removing in December next to 88, Charlotte Street, Fitzroy Square, W.

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s. each. SALMON ODY & CO., by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO., 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O. order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

Sale by Auction.

SCIENTIFIC AND MISCELLANEOUS PROPERTY.

Mr. J. C. STEVENS will Sell by Auction, at his Great Rooms, 38, King Street, Covent Garden, W.C., on FRIDAY, October 9, at half-past 12 o'clock precisely, Lathes and Tools, Model Engines, Electrical Apparatus, Chemicals, Surgical Instruments, Photographic Apparatus, Graphoscopes, Stereoscopes, and a great variety of Miscellaneous Articles.

On view the morning of sale, and catalogues had.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

INTERNATIONAL EXHIBITION PRIZE MEDAL AWARDS,

London, 1851. Paris, 1855. London, 1862. Vienna, 1873.

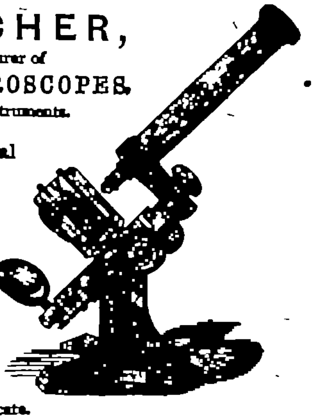
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,

Optician and Manufacturer of

ACHROMATIC MICROSCOPES,

and all kinds of Scientific Instruments.



Pillischer's St. Thomas's Hospital Microscope,

As supplied to the principal Universities and Hospitals.

Monocular, £5; Binocular, £10 10s.

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/25 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14s.; 4½ in., 17s.; 6 in., in Wooden Case, 10s., including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO

88, New Bond Street, W., London.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d. } Post-free.
,, Double ,, 31s. 6d., 42s., and 52s. 6d.
,, Umbilical ,, 42s. and 52s. 6d.

ELASTIC STOCKINGS, KNEE-CAPS, &c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

No. LVI., New Series, October, price 4s.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.

CONTENTS.

MEMOIRS—

A Preliminary Account of the Development of the Elasmobranch Fishes. By F. M. Balfour, B A, Trinity College, Cambridge. (With Three Plates)
Observations on the Development of the Pond-Snail (*Lymnæus stagnalis*), and on the Early Stages of other Mollusca. By E. Ray Lankester, M A, Fellow and Lecturer of Exeter College, Oxford. (With Two Plates.)
A Note on Endothelium. By John Cavafy, M.D., Assistant Physician and Lecturer on Physiology at St. George's Hospital.
Description of Apparatus for maintaining a Constant Temperature under the Microscope. By E. A. Schafer, Assistant Professor of Physiology in University College, London.

NOTES AND MEMORANDA—

On the Small-pox of Sheep—The Peach-coloured Bacterium—The Mode of Occurrence of Chlorophyll in Spongilla—Scalariform Ducts in the Prothalli of Ferns—Professor Haeckel's New Work.

QUARTERLY CHRONICLE OF MICROSCOPICAL SCIENCE
PROCEEDINGS of SOCIETIES

*** Vol. XIV New Series, with 17 Lithographic Plates and numerous Wood Engravings, cloth, 17s.

J & A. CHURCHILL, New Burlington Street.

THE QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R S, &c.

No XLIV., OCTOBER 1874, price 5s., contains :—

1—"An Examination of the Theories that have been proposed to account for the Climate of the Glacial Period" By Thomas Belt, F G.S
2.—"Loss of Life at Sea" By Rear-Admiral Fishbourne.
3—"The Lunar Atmosphere, and its Influence on Lunar Questions" By Edmund Neison, F R A.S, &c.
4—"Beryls and Emeralds." By Professor A. H. Church, M A., &c
5.—"On the Curved Appearance of Comets' Tails." By Lieut.-Col. Drayson, R A. F.R A S.
Notices of Books. Progress of the various Sciences, &c.

London: 3, Horseshoe Court, Ludgate Hill, E.C

Price 2s. 6d., free by post for 2s. 10d.

THE NEW QUARTERLY MAGAZINE

FOR OCTOBER.

CONTENTS.

"Travels in Portugal." (Concluded) By John Latouche.
"The Fauna of Fancy" By Frances Power Cobbe.
"A Sea Changeling." A Novel. By the Author of "Olive Varcoe."
"Spiritualism in England" By Nathaniel A Harness.
"The Character of Goethe." By Robert Buchanan, Author of "White Rose and Red."
"Small Farms" By Richard Jefferies.
"In the Rue Froide." A Tale. By Katharine S. Macquoid, Author of "Patty."

London: WARD, LOCK, & TYLER, Warwick House, *Paternoster Row.*

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s. 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, W.C.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, *Secretary to the Central Chamber of Agriculture,*

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this *Journal*, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations,

Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editor at the above address.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

NOW READY.

TECHNICAL TRAINING.

BY THOMAS TWINING,

ONE OF THE VICE-PRESIDENTS OF THE SOCIETY OF ARTS.

Being a Suggestive Sketch of a National System of Industrial Instruction founded on a General Diffusion of Practical Science among the People. 8vo. 12s.

MACMILLAN & CO., LONDON.

In crown 8vo, with 49 Diagrams, price 6s.

BRINKLEY'S ASTRONOMY, revised and partly rewritten, with Additional Chapters, and an Appendix of Questions for Examination. By JOHN WILLIAM STUBBS, D.D., Fellow and Tutor of Trinity College, Dublin; and FRANCIS BRUNNOW, Ph.D., Astronomer Royal of Ireland, and Professor of Astronomy in the University of Dublin. Second Edition, enlarged and improved.

London: LONGMANS & CO.

SCIENTIFIC WORKS BY THE REV. PROVOST LLOYD.

Now ready, in 8vo, price 10s. 6d. cloth.

A TREATISE on MAGNETISM, General and Terrestrial. By HUMPHREY LLOYD, D.D. D.C.L., Provost of Trinity College, Dublin, Professor of Natural Philosophy in the University.

By the same Author, Third Edition, price 10s. 6d.

The WAVE-THEORY of LIGHT.

London: LONGMANS & CO.

Nearly ready, in One Volume, crown 8vo, with 20 Plates and numerous Woodcut Illustrations

TRANSITS of VENUS: a Popular Account of Past and Coming Transits from the first observed by Horrocks, A.D. 1639, to the Transit of A.D. 2012. By RICHARD A. PROCTOR, B.A. &c., Author of "The Sun," "Other Worlds than Ours," "The Universe," &c.

London: LONGMANS & CO.

SCIENCE PRIMERS IN PREPARATION.

INTRODUCTORY. By Professor Huxley, F.R.S.

BOTANY. By J. D. Hooker, C.B. F.R.S., President of the Royal Society.

ASTRONOMY. By J. Norman Lockyer, F.R.S.

MACMILLAN & CO., LONDON.

The EARTH as MODIFIED by HUMAN ACTION.

A New Edition of "Man and Nature." By GEORGE P. MARSH.

8vo, cloth, 18s.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, Crown Buildings, 188, Fleet Street, E.C.

Dr. Russell Reynolds' SYSTEM of MEDICINE. In 8vo, price 25s. each.

Vol. I.—GENERAL DISEASES: or, Affections of the Whole System. Second Edition.
Vol. II.—DISEASES of the NERVOUS SYSTEM and of the STOMACH. Second Edition.
Vol. III.—DISEASES of the DIGESTIVE SYSTEM (continued), Diseases of the Mouth; Diseases of the Respiratory System.
Vol. IV.—DISEASES of the CIRCULATORY SYSTEM, the Blood-Glandular, the Urinary, the Reproductive, and Cutaneous Systems. [*In preparation.*

MACMILLAN & CO., London.

Just published, price 3s. 6d.

On PROTOPLASM; being an Examination of Dr. James Hutchinson Stirling's Criticism of Prof Huxley's Views. By JAMES ROSS, M.D.

London: ROBERT HARDWICKE, 192, Piccadilly.

On Oct. 10, Fifth Edition, considerably Extended, with 40 Wood Engravings, Frontispiece, and 8 new Panoramic Maps, post 8vo, 12s. 6d.

WINTER and SPRING on the SHORES of the MEDITERRANEAN, or the Rivieras, Italy, Spain, Greece, Constantinople, the Archipelago, Corsica, Sicily, Sardinia, Algeria, Tunis, Smyrna, with Biarritz and Arcachon, as Winter Climates.

By DR. HENRY BENNET.

J. & A. CHURCHILL, New Burlington Street.

WORKS IN MEDICINE, &c.

Dr. McCall Anderson on the TREATMENT of DISEASES of the SKIN; with an Analysis of Eleven Thousand Consecutive Cases. Crown 8vo, 5s.

Dr. T. Clifford Allbutt on the USE of the OPHTHALMOSCOPE in DISEASES of the NERVOUS SYSTEM and of the KIDNEYS; also in certain other General Disorders. 8vo, 15s.

Dr. Wilson Fox on DISEASES of the STOMACH. Being a Third and Revised Edition of the DIAGNOSIS and TREATMENT of the VARIETIES of DYSPEPSIA. 8vo, 8s. 6d.

Dr. Wilson Fox on the ARTIFICIAL PRODUCTION of TUBERCLE in the LOWER ANIMALS. With Plates, 4to, 5s. 6d.

Dr. Wilson Fox on the TREATMENT of HYPERPYREXIA as illustrated in Acute Articular Rheumatism by means of the External Application of Cold. 8vo, 2s. 6d.

Professor Flower's INTRODUCTION to the OSTEOLOGY of the MAMMALIA. Lectures at the Royal College of Surgeons. With Illustrations. Globe 8vo, 7s. 6d.

Dr. Wharton Hood on BONE-SETTING (so called) and its Relation to the Treatment of Joints crippled by Injury, Rheumatism, Inflammation, &c. Crown 8vo, 4s. 6d.

Dr. H. Maudsley's BODY and MIND: an Inquiry into their Connection and Mutual Influence, specially in reference to Mental Disorders. New Edition, with Psychological Essays added. Crown 8vo, 6s. 6d.

Dr. J. Macpherson's OUR BATHS and WELLS: the Mineral Waters of the British Islands; with a List of Sea-bathing Places. Fcap. 8vo, 3s. 6d.

Dr. J. Macpherson's The BATHS and WELLS of EUROPE: their Action and Uses; with Notices of Climatic Resorts and Diet Cures. New Edition, Revised and Enlarged. Extra fcap. 8vo, 6s. 6d.

Dr. E. C. Seaton's HANDBOOK of VACCINATION. Extra fcap. 8vo, 8s. 6d.

MACMILLAN & CO., LONDON.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative. 16 Plates, 10s. 6d. Now ready, Third Edition. J. & A. Churchill.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d. J. & A. Churchill.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12s. 6d. J. & A. Churchill.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS. Third Edition, 25s. J. & A. Churchill.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s. 6d. A. Churchill.
6. The MICROSCOPE in MEDICINE. Fourth Edition much large. J. & A. Churchill. [In the Pro
7. HOW to WORK with the MICROSCOPE. 21s. Harrison, Pall M

DIARY OF SOCIETIES.

LONDON

FRIDAY, OCTOBER 9.

JUNIOR PHILOSOPHICAL SOCIETY, at 7.30.—Introductory Address by the President.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	*s.*	*d.*
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 o'clock on Wednesdays.

Post-office Orders payable to MACMILLAN & CO.

OFFICE: BEDFORD STREET, STRAND, W.C.

THE GREAT FUNGUS MEETINGS AT HEREFORD AND LONDON.

The *Gardeners' Chronicle* for Oct 10 (price 5*d*, post free 5½*d*) will contain exclusive reports, in full detail, from the pen of Mr Worthington G. Smith, of these great meetings for the determination and consumption of Edible Fungi

Published by W. RICHARDS, 41, Wellington Street, Covent Garden, W.C.

TISLEY'S PENDULUM APPARATUS,

	£	s.	d.
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on — — — — — — — — —	£12	0	0
Reflectors for projecting the Figures on the Screen — —	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen ...	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3 ...	0	7	6
Ditto traced on blackened Glass, for the Lantern ... per slide ...	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution ... £5 5 0

TISLEY AND SPILLER, OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent, No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences

6*d.* MONTHLY, or POST-FREE, 6*s.* 6*d.* PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—

The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress

⁂ This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

"NATURE" SERIES.

A SERIES OF POPULAR SCIENTIFIC WORKS.

Vol. I.—The SPECTROSCOPE and its APPLICATIONS. By J. Norman Lockyer, F.R.S. With numerous Illustrations. Second Edition, crown 8vo, 3*s*. 6*d*.

"To any student who wishes to make himself, in a comparatively short time, well acquainted with the principles and the application of the spectroscope, we cannot recommend a better treatise."—*Westminster Review.*

Vol. II.—The ORIGIN and METAMORPHOSIS of INSECTS. By Sir John Lubbock, M.P. F.R.S. With numerous Illustrations. Second Edition, crown 8vo, 3*s*. 6*d*.

"We invite attention to the admirable manner in which the subject of insect metamorphosis is illustrated by excellent figures." —*Field.*

Vol. III.—The BIRTH of CHEMISTRY. By G. F. Rodwell, F.R.A.S. F.C.S., Science Master in Marlborough College. With numerous Illustrations. Crown 8vo, 3*s*. 6*d*.

"Mr. Rodwell's work is the product of scholarly investigation. Chemists cannot fail to enjoy it, and those who are not chemists will be tempted to enter on the study of its mysteries."—*Chemist and Druggist.*

"A thoughtful, suggestive, and decidedly readable work."—*Quarterly Journal of Science.*

The TRANSIT of VENUS. By George Forbes, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With numerous Illustrations. Crown 8vo, 3*s*. 6*d*.

To be shortly published.

POLARISATION of LIGHT. By W. Spottiswoode, LL.D. F.R.S. With numerous Illustrations. Crown 8vo.

The COMMON FROG. By St. George Mivart, F.R.S., Lecturer on Comparative Anatomy at St. Mary's Hospital. With numerous Illustrations. Crown 8vo.

On BRITISH WILD FLOWERS, considered in RELATION to INSECTS. By Sir JOHN LUBBOCK, M.P. F.R.S. With numerous Illustrations. Crown 8vo.

MACMILLAN & CO., LONDON.

Just Published. 8vo. Price 14*s*.

A MANUAL OF THE CHEMISTRY OF THE CARBON COMPOUNDS; OR, ORGANIC CHEMISTRY.

By C. SCHORLEMMER, F.R.S.,

LECTURER ON ORGANIC CHEMISTRY IN THE OWENS COLLEGE, MANCHESTER.

"Nor is Mr. Schorlemmer appreciated by the profession for his experimental researches only; his fame is even more widely spread by his 'Manual of Organic Chemistry.' This is one of the favourite works from which the present generation of young chemists derive their information. Having myself to teach a large class of students, I have continuous opportunities of recommending this work and of observing the benefit derived from this recommendation."—PROF HOFMANN.

London: MACMILLAN AND CO.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR OCTOBER 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF OCTOBER NUMBER.—Our Illustrations:—1. Gibson's "Venus," from the Original Study. 2. Fresco by Correggio. 3. "Hope," by Puvis De Chavannes.—Foley's Place among British Sculptors.—The Revised Theory of Light, by W. Cave Thomas, No. 2.—The Golden Wedding of Mr. and Mrs. S. C. Hall.—Art Notes and Gossip.—The Decoration of St. Paul's Cathedral (Letter No. 4.)

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

AGRICULTURAL PUBLICATIOS.

THE PROPORTIONATE FATTENING and FLESH-FORMING C LITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of esidue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-op many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to in illing, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragem opera- tion in Agriculture and in general Trading. Price 6*d.* per month, or 5*s.* per annum, post-free.

Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7*s.* 6*d.* each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOI n Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Supe , Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the its 18c gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25*s* to 45*s*. Alberts, 2*s*. to 5*s*.; Long Chains, 5*s*. to 8*s*. 6*d*.; Lockets, 2*s* to 5*s*. 6*d*.; Crosses, 1*s*. 6*d*. to 4*s* 6*d*; Ladies' Gem Rings, 2*s* 5*s*.; Wedding and Keeper Rings, 1*s*. to 2*s*. 6*d*., Gents' Finger Rings, 2*s* 6*d* to 6*s*.; Bracelets, 5*s* to 10*s*. 6*d*.: Studs, 1*s*. to 3*s*. 6*d*; Links, 1*s* to 3*s* Breast Pins, 1*s* to 4*s*. 6*d*; Brooches, 1*s*. 6*d*. to 7*s* 6*d*, Ear Rings, 1*s*. 6*d*. to 6*s*. 6*d*.: Sets (*en suite*), Brooch and Ear Rings, 5*s* 6*d* to 10*s* 6*d*.; Penc Cases, 2*s*. to 4*s* 6*d*., Gents' Snake Rings (Plain Head), 3*s*. 6*d*, Head set with Brilliant, &c, 5*s*.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years. Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "**MAZELINE**" **GOLD JEWELLERY** to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P O O. to be made payable at Post Office, Bishopsgate Street Without, London, E C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

Price 14*s*., with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

London: MACMILLAN & Co.

BRYANT & MAY'S
MATCHES.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible].)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests, Subscription, 16*s* 6*d* per annum, post free, dating from any quarter-day Single Copies, 1*s*. each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

HOLLOWAY'S PILLS.—For the cure of bilious complaints, indigestion, and affections of the liver Symptoms indicative of these disorders are a feeling of nausea, distention and spasmodic pains in the stomach, sense of oppression and sinking after eating, want of appetite, languor, dejection of spirits, and general debility The removal of the cause is the most important step, for which have recourse to Holloway's Pills, as they possess such cleansing properties that the action of the liver is speedily corrected, the redundancy of bile carried off, the stomach strengthened, the spirits revived and patient restored. These excellent Pills keep all the natural functions so fairly balanced that they prevent or speedily subdue headache, dizziness, bilious attacks, and similar maladies

EDUCATIONAL WORKS.

SCIENCE PRIMERS.

UNDE JOINT EDITORSHIP OF PROFESSORS LEY, ROSCOE, AND BALFOUR STEWART.

“They are ly clear and lucid in their instruction, simple in style, whuable in plan.”—*Educational Times.*

lowing are Now Ready:—

CHEMIS By H. E. Roscoe, F.R.S., Profes emistry in Owens College, Manchester. Third E 18mo, cloth, illustrated, 1s.

PHYSI By Balfour Stewart, F.R.S., Profe tural Philosophy in Owens College, Manches nd Edition. 18mo, cloth, illustrated, 1s

PHY GEOGRAPHY. By A. Geikie, F. hison Professor of Geology and Mineralogy at E Second Edition. 18mo, cloth, illustrated, 1s.

GE By Professor Geikie, F.R.S. ous Illustrations. 18mo, cloth, 1s.

PH OGY. By Michael Foster, M.D. ith numerous Illustrations. 18mo, 1s.

ENCE CLASS-BOOKS.

IY.—ELEMENTARY LESSONS TOMY. By ST. GEORGE MIVART, F.R.S. merous Illustrations. 18mo, 6s. 6d.

ONOMY.—POPULAR ASTRO- . With Illustrations. By Sir G. B. AIRY, Astro-Royal. New Edition. 18mo, 4s. 6d.

ONOMY.—ELEMENTARY LES- S in ASTRONOMY. With Illustrations. By J. MAN LOCKYER, F.R.S. With Coloured Dia of the Spectra of the Sun, Stars, and Nebulæ. New ion. 18mo, 5s. 6d.—QUESTIONS on the SAME, 6d.

ANY.—LESSONS in ELEMENTARY OTANY. With Illustrations. By Prof. OLIVER, .R.S. F.L.S. New Edition. 18mo, 4s. 6d.

EMISTRY.—LESSONS in ELEMEN- TARY CHEMISTRY. By Professor ROSCOE, F.R.S. With numerous Illustrations and Chromo-lithographs of the Solar Spectra. New Edition. 18mo, 4s. 6d.

HEMISTRY.—OWENS COLLEGE JUNIOR COURSE of PRACTICAL CHEMISTRY. By F. JONES. With Preface by Professor ROSCOE. New Edition. 18mo, 2s. 6d.

LOGIC.—ELEMENTARY LESSONS in LOGIC, DEDUCTIVE and INDUCTIVE. By Professor JEVONS, F.R.S. With copious Questions and Examples, and a Vocabulary of Logical Terms. New Edition. 18mo, 3s. 6d.

PHYSIOLOGY.—LESSONS in ELEMEN- TARY PHYSIOLOGY. With numerous Illustrations. By Professor HUXLEY, F.R.S. New Edition. 18mo, 4s. 6d.—QUESTIONS on the SAME, 1s. 6d.

POLITICAL ECONOMY.—POLITICAL ECONOMY for BEGINNERS. By MILLICENT GARRETT FAWCETT. With Questions. New Edition. 18mo, 2s. 6d.

PHYSICS.—LESSONS in ELEMENTARY PHYSICS. By BALFOUR STEWART, F.R.S., Professor of Natural Philosophy in Owens College, Manchester. With Coloured Diagram and numerous Illustrations. New Edition. 18mo, 4s. 6d.

STEAM.—An ELEMENTARY TREATISE on STEAM. By J. PERRY, B.E., Whitworth Scholar, late Lecturer in Physics at Clifton College. With Illustrations, Numerical Examples, and Exercises. 18mo, 4s. 6d.

*** *Others to follow.*

BY THE REV. BARNARD SMITH, M.A.

ARITHMETIC and ALGEBRA. Twelfth Edition. Crown 8vo, cloth, 10s. 6d.

ARITHMETIC for the USE of SCHOOLS. New Edition. Crown 8vo, 4s. 6d.—KEY, 8s. 6d.

EXERCISES in ARITHMETIC. With ANSWERS. Crown 8vo, limp cloth, 2s. 6d. Separately, Part I., 1s.; Part II., 1s.—ANSWERS, 6d.

SHILLING BOOK of ARITHMETIC. For National and Elementary Schools. 18mo. Or separately, Part I., 2d.; Part II., 3d.; Part III., 7d. With ANSWERS, 18mo, 1s. 6d.—KEY, 4s. 6d.

EXAMINATION PAPERS in ARITHMETIC. In Four Parts. New Edition. 18mo, 1s. 6d. Ditto, with ANSWERS, 18mo, 1s. 9d.—KEY, 18mo, 4s. 6d.

SCHOOL CLASS-BOOK of ARITHMETIC. 18mo, 3s. Or Parts I. and II., 10d. each, and Part III., 1s.—KEY, complete, 18mo, 6s. 6d.; or Three Parts, 2s. 6d. each.

THE METRIC SYSTEM of ARITHMETIC: its Principles and Application. With numerous Examples. Written expressly for Standard V. in National Schools. Fourth Edition. 18mo, cloth, sewed, 3d.

A CHART of the METRIC SYSTEM, for School Walls. On Roller, 1s. 6d.; on Roller, mounted and varnished, 3s. 6d. Third Edition. With a full-length METRE MEASURE, subdivided into Decimètres, Centimètres, and Millimètres.

Also, a SMALL CHART, on Card. 1d.

EASY LESSONS in ARITHMETIC. Combining Exercises in Reading, Writing, Spelling, and Dictation. Part I. for Standard I. in National Schools. Crown 8vo, cloth, sewed, 9d.

DIAGRAMS for SCHOOL WALLS in preparation.

BY I. TODHUNTER, M.A. F.R.S.

EUCLID for COLLEGES and SCHOOLS. New Edition. 18mo, 3s. 6d.

MENSURATION for BEGINNERS. With Examples. New Edition. 18mo, 2s. 6d.

ALGEBRA for BEGINNERS. With numerous Examples. New Edition. 18mo, 2s. 6d.—KEY, 6s. 6d.

TRIGONOMETRY for BEGINNERS. With numerous Examples. New Edition. 18mo, 2s. 6d.—KEY, 8s. 6d.

MECHANICS for BEGINNERS. With numerous Examples. New Edition. 18mo, 4s. 6d.

ALGEBRA for the USE of COLLEGES and SCHOOLS. Sixth Edition. Crown 8vo, 7s. 6d.—KEY, 10s. 6d.

An ELEMENTARY TREATISE on the THEORY of EQUATIONS. Second Edition, revised. Crown 8vo, 7s. 6d.

PLANE TRIGONOMETRY. Fourth Edition. Crown 8vo, 5s.

A TREATISE on SPHERICAL TRIGONOMETRY. Third Edition. Crown 8vo, 4s. 6d.

A TREATISE on CONIC SECTIONS. With Examples. Fifth Edition. Crown 8vo, 7s. 6d.

A TREATISE on the DIFFERENTIAL CALCULUS. With Examples. Sixth Edition. Crown 8vo, 10s. 6d.

MACMILLAN & CO., LONDON.

Printed by R. Clay, Sons, & Taylor, at 7 and 8, Bread Street Hill, in the City of London, and published by Macmillan & Co., at the Office, 29 and 30, Bedford Street, Covent Garden.—Thursday, October 8, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 259, Vol. 10] THURSDAY, OCTOBER 15, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office

[All Rights are Reserved.

LONDON LIBRARY,

12, ST. JAMES'S SQUARE.—Founded in 1841.

Patron—H.R.H. The Prince of Wales.

President—Thomas Carlyle, Esq.

This Library contains 90,000 Volumes of Ancient and Modern Literature, in various Languages. Subscription, £3 a year, or £2 with Entrance Fee of £6; Life Membership, £26.

Fifteen Volumes are allowed to Country, and Ten to Town Members. Reading Room open from Ten to half-past Six. Prospectus on application. Catalogue, New Edition, in the press.

ROBERT HARRISON, Secretary and Librarian.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F.R.S.; Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and Investigations conducted.—Apply to Prof. E. V. Gardner, F.E.S., F.S.A., 44, Berners Street, W.

LADIES' EDUCATIONAL ASSOCIATION, in connection with University College, London.—The Day Classes for Ladies, of English, French, and Italian Languages and Literature, Logic (elementary and advanced), Constitutional History, and Chemistry, will open at University College on and after MONDAY, Oct. 26. Prospectuses to be had at the Office in the College, or of J. E. Mylne, Esq., 27, Oxford Square, Hyde Park, W.

PRELIMINARY EXAMINATIONS of the COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr. J. ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations. For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c., address to 3, Pump Court, Temple, or to the care of Messrs. Butterworth, 7, Fleet Street, her Majesty's Publishers.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils, to prepare for the Universities and other examinations; and has now Vacancies.

Mr. C. H. LAKE (Graduate in Honours, London) receives a limited number of RESIDENT PUPILS. Testimonials from the late J. S. Mill, Dr. Tyndall, &c. Science receives careful attention.—Witherndon, Caterham, Surrey.

PREPARATION for the Public Schools by an Oxford M.A. and First Classman. Natural Science included in the ordinary scheme of work.—Address J. L. Watson, Esq., Richmond House, Worthing, Sussex.

TUITION in CLASSICS, ENGLISH LANGUAGE, HISTORY, and LITERATURE.—An experienced Tutor attends Schools and Families, in London or the Country, to teach the above Subjects. Prepares for the Public Schools, Universities, and the Army.—Address Tutor, 15, Gledhow Terrace, South Kensington, S.W.

SCIENTIFIC and LITERARY SOCIETIES requiring ROOMS for MEETINGS, REFRESHMENT, &c., may hear of excellent Accommodation at a Moderate Cost by applying to Mr. Poole, 11, Chandos Street, Cavendish Square, W.

CABINETS for COLLECTIONS of Natural History Specimens, Glass-top Boxes, Books, Maps, Specimens, &c., of JAMES R. GREGORY, 15, Russell Street, Covent Garden. Catalogues of Specimens, Apparatus, &c., 74 pages, post-free for six stamps. Removing in December next to 88, Charlotte Street, Fitzroy Square.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c., of J. TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S., at his residence, 149, Strand, W.C.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 25s.; 200 ditto, £2 10s. to £3 10s.; 300 ditto, £4 10s. to £6, 400 ditto, £6 to £8, 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples, £3 10s. 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s.; 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6. RECENT SHELLS: 100 genera, £1, 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

SCIENCE TUITION by CORRESPONDENCE.—For terms, apply to D.C.L., care of Macmillan and Co., 29, Bedford Street, Strand, London, W.C.

PRIVATE TUITION.—A Clergyman of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS. Home comforts combined with great educational advantages. The highest references.—M.A., care of Editor of Nature, 29, Bedford Street, Strand, W.C.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s each SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s ; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints, and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O order.—ALEX. ROSS, 248, High Holborn, London ; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain Price 10s. 6d., sent carriage-free for P.O order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps

---

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.

(Late of Arundel Street.)

British Rocks—100 Specimens	One Guinea.
British Fossils—100 "	One Guinea.

Collections and Specimens of

British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK
DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens.
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

HOLLOWAY'S OINTMENT and PILLS. —Diseases and casualty incidental to youth may be safely treated by the use of these excellent medicaments according to the printed directions folded round each pot and box. This Ointment is not alone applicable to external ailments; conjointly with the Pills it exercises the most salutary influence in checking inflammations in the interior of the body; when rubbed upon the back and chest it gives most sensible relief in asthma, bronchitis, pleurisy, and threatening consumption Holloway's remedies are especially serviceable in liver and stomach complaints. For the cure of bad legs, all sorts of wounds, sores, and likewise scrofula and scorbutic affections, this Ointment produces a cooling and soothing feeling most acceptable to the sufferer.

W. LADD & CO.
SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c—Much trouble may be saved in grinding up colours to a uniform tint They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water They sink deeply into the fibre, and will not rub off They form the most economical stain on record. Light Brown for mahogany colour is excellent; No 2 Black for walnut, Canary for satin ; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

FRY'S

VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J S. FRY & SONS.

CARACAS COCOA

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

THE QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R S , &c.

No XLIV., OCTOBER 1874, price 5s., contains :—

1 —"An Examination of the Theories that have been proposed to account for the Climate of the Glacial Period." By Thomas Belt, F.G S.
2.—"Loss of Life at Sea" By Rear-Admiral Fishbourne.
3 —"The Lunar Atmosphere, and its Influence on Lunar Questions." By Edmund Nelson, F R A S., &c.
4.—"Beryls and Emeralds." By Professor A H. Church, M A., &c
5.—"On the Curved Appearance of Comets' Tails." By Lieut.-Col. Drayson, R A. F R A.S.
Notices of Books. Progress of the various Sciences, &c.

London : 3, Horseshoe Court, Ludgate Hill, E.C.

Second Edition Now ready.

THE NEW QUARTERLY MAGAZINE

FOR OCTOBER. Price 2s. 6d., free by post 2s. 10d.

CONTENTS.

"Travels in Portugal." (Concluded) By John Latouche.
"The Fauna of Fancy." By Frances Power Cobbe.
"A Sea Changeling." A Novel. By the Author of "Olive Varcoe"
"Spiritualism in England." By Nathaniel A Harness.
"The Character of Goethe." By Robert Buchanan, Author of "White Rose and Red."
"Small Farms" By Richard Jefferies.
"In the Rue Froide." A Tale. By Katherine S. Macquoid, Author of "Patty."

London : WARD, LOCK, & TYLER, Warwick House, Paternoster Row.

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences.

6d. MONTHLY, or POST-FREE, 6s. 6d PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—
The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions.
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

*** This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M B, F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s. 6d. bound in cloth); also covers for the volume (price 1s.), and back numbers.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations,

Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F L.S , Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages

The following are some of the subjects regularly treated of in its pages :—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4d. per Copy. It may also be had direct from the Office at 5s. for a Quarter, 9s. 9d. for a Half-year, and 19s 6d. for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½d.

37, Southampton Street, Covent Garden, W C.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10s. 6d.

Cloth Cases for binding all the volumes, price 1s. 6d. each.

Reading Cases to hold 26 numbers, price 2s. 6d.

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

SCOTTISH PROVIDENT INSTITUTION,

Established 1837

6, ST. ANDREW SQUARE, EDINBURGH; 18, KING WILLIAM STREET, LONDON, E.C.

The PREMIUM usually charged for £1,000 will here, in most cases, assure £1,200 or £1,250 from the first, the difference being equivalent to an *immediate* and certain Bonus of 20 to 25 per cent.

The WHOLE PROFITS are reserved for those who prove good lives. The additions to policies now sharing for the first time vary (according to the values) from about 17 to upwards of 30 per cent. Policies, say for £1,000, which now receive a second addition, have been raised to £1,250 or £1,450. In a few cases, policies which have shared at the whole four divisions have been doubled.

Examples of Annual Premium by different Modes of Payment for Assurance of £100 at death (with profits).

Age.	Payable during life.	Premiums limited to 20 payments.	Premiums limited to 10 payments.	Age.	Payable during life.	Premiums limited to 20 payments.	Premiums limited to 10 payments.
25	£1 18 0	£2 13 8	£4 5 7	40	£2 14 9	£3 8 10	£5 7 11
30	2 1 6	2 16 8	4 10 3	45	3 5 9	3 19 0	6 1 2
35	2 6 10	3 1 6	4 17 7	50	4 1 7	4 13 8	6 19 7

INTENDING ASSURERS are invited to compare these rates with the corresponding scales of other offices.

The Funds exceed £2,250,000.

Notwithstanding its low rates, no Office of the same age has so large a Fund, or shows so large a Yearly Increase.

Copies of the 36th Annual Report, with particulars of the recent investigation and every information may be had on application.

NEW WORKS BY THE REV. J. G. WOOD, M.A.

Author of "Homes Without Hands," &c.

OUT of DOORS: a Selection of Original

Articles on Practical Natural History, uniform with "Strange Dwellings" by the same Author; with 6 Illustrations from Original Designs engraved on Wood by G. Pearson. Crown 8vo, price 7s. 6d. cloth. [On Nov. 2.

INSECTS ABROAD: a Popular Account

of Foreign Insects, their Structure, Habits, and Transformations. With 600 Figures by E. A. Smith and J. B. Zwecker, engraved on Wood by G. Pearson. Forming a Sequel or Companion Volume to "Insects at Home" by the same Author. 8vo, price 21s. cloth. [On Nov. 2.

London: LONGMANS & CO.

Now ready, with Engravings, post 8vo, 7s. 6d.

PRACTICAL and ANALYTICAL CHEMISTRY:

an Elementary Treatise specially adapted for Schools and Colleges and by Beginners. By FRANK CLOWES, B Sc., Science Master at Queenwood College.

J. & A. CHURCHILL, New Burlington Street.

On Oct. 10, Fifth Edition, considerably Extended, with 40 Wood Engravings, Frontispiece, and 8 new Panoramic Maps, post 8vo, 12s. 6d.

WINTER and SPRING on the SHORES

of the MEDITERRANEAN; or the Rivieras, Italy, Spain, Greece, Constantinople, the Archipelago, Corsica, Sicily, Sardinia, Algeria, Tunis, Smyrna, with Biarritz and Arcachon, as Winter Climates.

By DR. HENRY BENNET.

J. & A. CHURCHILL, New Burlington Street.

Dr. Russell Reynolds' SYSTEM of MEDICINE.

In 8vo, price 25s. each.

Vol. I.—GENERAL DISEASES: or, Affections of the Whole System. Second Edition.

Vol. II.—DISEASES of the NERVOUS SYSTEM and of the STOMACH. Second Edition.

Vol. III.—DISEASES of the DIGESTIVE SYSTEM (continued), Diseases of the Mouth; Diseases of the Respiratory System.

Vol. IV.—DISEASES of the CIRCULATORY SYSTEM, the Blood-Glandular, the Urinary, the Reproductive, and Cutaneous Systems. [*In preparation.*

MACMILLAN & CO., London.

Just published, price 3s. 6d.

On PROTOPLASM; being an Examination

of Dr James Hutchinson Stirling's Criticism of Prof. Huxley's Views. By JAMES ROSS, M.D.

London: ROBERT HARDWICKE, 192, Piccadilly.

In crown 8vo, with 49 Diagrams, price 6s.

BRINKLEY'S ASTRONOMY, revised and

partly rewritten, with Additional Chapters, and an Appendix of Questions for Examination. By JOHN WILLIAM STUBBS, D.D., Fellow and Tutor of Trinity College, Dublin; and FRANCIS BRUNNOW, Ph.D., Astronomer Royal of Ireland, and Professor of Astronomy in the University of Dublin. Second Edition, enlarged and improved.

London: LONGMANS & CO.

AN ELEMENTARY TREATISE ON

STEAM. By JOHN PERRY, B.E., Whitworth Scholar, F.C.S., late Lecturer on Physics at Clifton College. 4s. 6d.

When boys have acquired an elementary knowledge of Experimental Mechanics and Heat it is well to teach them the application of the principles they have learnt, by some such course as is sketched in the present work, before proceeding to Electricity, Acoustics, and Light. The numerous examples and exercises will prove useful in all Physics classes; whether the whole course is followed or not; to candidates for scholarships at the Universities and to boys preparing for the examinations at Woolwich and Cooper's Hill.

MACMILLAN & CO., LONDON.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative 16 Plates, 10s. 6d. Now ready, Third Edition. J. & A. CHURCHILL.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d. J. & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12s. 6d. J. & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS. Third Edition, 25s. J. & A. CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s. 6d. J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition much enlarged. J. & A. CHURCHILL. [In the Press.
7. HOW to WORK with the MICROSCOPE. 21s. HARRISON, Pall Mall.

WORKS IN MEDICINE, &c.

Dr. McCall Anderson on the TREATMENT

of DISEASES of the SKIN; with an Analysis of Eleven Thousand Consecutive Cases. Crown 8vo, 5s.

Dr. T. Clifford Allbutt on the USE of the

OPHTHALMOSCOPE in DISEASES of the NERVOUS SYSTEM and of the KIDNEYS; also in certain other General Disorders. 8vo, 15s.

Dr. Wilson Fox on DISEASES of the

STOMACH. Being a Third and Revised Edition of the DIAGNOSIS and TREATMENT of the VARIETIES of DYSPEPSIA. 8vo, 8s. 6d.

Dr. Wilson Fox on the ARTIFICIAL PRODUCTION

of TUBERCLE in the LOWER ANIMALS. With Plates, 4to, 5s. 6d.

Dr. Wilson Fox on the TREATMENT of

HYPERPYREXIA as Illustrated in Acute Articular Rheumatism by means of the External Application of Cold. 8vo, 2s. 6d.

Professor Flower's INTRODUCTION to

the OSTEOLOGY of the MAMMALIA. Lectures at the Royal College of Surgeons. With Illustrations. Globe 8vo, 7s. 6d.

Dr. Wharton Hood on BONE-SETTING

(so called) and its Relation to the Treatment of Joints crippled by Injury, Rheumatism, Inflammation, &c. Crown 8vo, 4s. 6d.

Dr. H. Maudsley's BODY and MIND: an

Inquiry into their Connection and Mutual Influence, specially in reference to Mental Disorders. New Edition, with Psychological Essays added. Crown 8vo, 6s 6d.

Dr. J. Macpherson's OUR BATHS and

WELLS: the Mineral Waters of the British Islands; with a List of Sea-bathing Places. Fcap 8vo, 3s. 6d.

Dr. J. Macpherson's The BATHS and

WELLS of EUROPE: their Action and Uses; with Notices of Climatic Resorts and Diet Cures. New Edition, Revised and Enlarged. Extra fcap. 8vo, 6s. 6d.

Dr. E. C. Seaton's HANDBOOK of VACCINATION.

Extra fcap. 8vo, 8s. 6d.

MACMILLAN & CO., LONDON.

DIARY OF SOCIETIES.

LONDON

FRIDAY, OCTOBER 16

MEDICAL MICROSCOPICAL SOCIETY, at 8.—Opening Meeting of the Session.

FRIDAY, OCTOBER 23.

QUEKETT MICROSCOPICAL CLUB, at 8.—On cutting Sections of the Eyes of Insects, and on a New Instrument for that purpose: R. P. Williams

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	s.	d.
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to MACMILLAN & CO.

OFFICE: BEDFORD STREET, STRAND, W.C.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s*, 21*s*, 26*s*. 6*d*., and 31*s*. 6*d*.
,, Double ,, 31*s*. 6*d*., 42*s*., and 52*s*. 6*d*.
,, Umbilical ,, 42*s*. and 52*s*. 6*d*.
Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s*. 6*d*., 7*s*. 6*d*., 10*s*., and 16*s*. each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

NATURE.—Wanted clean Copies of Nos. 10, 13, 116, and 203 with Portrait. NATURE Office, 29, Bedford Street, Strand, W.C.

TISLEY'S

PENDULUM APPARATUS,

	£	s.	d.
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet (3 ft. × 1 ft. square), which serves as a Stand for the instrument to work on — — — — — — — — —	12	0	0
Reflectors for projecting the Figures on the Screen — —	2	12	6
N.B.—Specimen Curves, on card, post free — per dozen —	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3 —	0	7	6
Ditto traced on blackened Glass, for the Lantern — per doz. —	0	3	6

EDUCATIONAL SET OF ACOUSTIC APPARATUS,

For performing many of the experiments, included in the Christmas Lectures given by Dr. Tyndall at the Royal Institution — £5 5 0

TISLEY AND SPILLER, OPTICIANS, &c.,

172, BROMPTON ROAD, S.W.

(Three minutes' walk from South Kensington Museum).

SCIENCE PRIMERS IN PREPARATION.

INTRODUCTORY. By Professor Huxley, F.R.S.

BOTANY. By J. D. Hooker, C.B. F.R.S., President of the Royal Society.

ASTRONOMY. By J. Norman Lockyer, F.R.S.

MACMILLAN & CO., LONDON.

"NATURE."

The FOURTH EDITION of NATURE for AUGUST 20, containing a STEEL ENGRAVING of PROFESSOR TYNDALL and his INAUGURAL ADDRESS at the MEETING of the BRITISH ASSOCIATION at BELFAST, is NOW EXHAUSTED with the exception of A VERY FEW COPIES, which may be had at the Office, price ONE SHILLING each.

29, Bedford Street, Strand.

THE ZOOLOGIST:

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists;" those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

NEW AND FORTHCOMING BOOKS.

BY SIR SAMUEL W. BAKER, PASHA, F.R.S., ETC.

Ismailia: a Narrative of the Expedition to Central Africa for the Suppression of the Slave Trade, organised by ISMAIL, KHEDIVE OF EGYPT. With Maps, Portraits, and upwards of Fifty full-page Illustrations by ZWECKER and DURAND. Two vols. 8vo. 36*s*.

The Russian Power. By Ashton W. Dilke. With Maps and Illustrations. Two vols. Medium 8vo. 32*s*.

Biography of the Right Hon. Francis BLACKBURNE, late Lord Chancellor of Ireland. Chiefly in Relation to his Public and Political Career. By his SON. 8vo. 12*s*.

Lady Duff Gordon's Last Letters from Egypt, to which are added Letters from the Cape. With a Memoir by her DAUGHTER. With Portrait engraved by JEENS after PHILLIPS. Crown 8vo. 9*s*.

A Ramble Round the World, 1871. *By* M. LE BARON DE HÜBNER, formerly Ambassador and Minister. Translated by Lady HERBERT. Two vols. 8vo. 25*s*. [Next week.

Outlines of Cosmic Philosophy, based on the Doctrine of Evolution, with Criticisms on the Positive Philosophy. By JOHN FISKE, M.A., LL.B., formerly Lecturer on Philosophy at Harvard University. Two Vols. 8vo. 25*s*.

Milton's Poetical Works. Edited, with Text Collated from the best Authorities, with Introduction and Notes, by DAVID MASSON, Professor of Rhetoric and English Literature in the University of Edinburgh. With Three Portraits engraved by C. H. JEENS and RADCLIFFE. Three vols. 8vo. (Uniform with the Cambridge Shakespeare.) 42*s*.

Milton's Poetical Works (Golden Treasury Edition). With Introduction and Notes, by Professor MASSON. With Two Portraits engraved by JEENS. Two vols. 18mo. 9*s*.

Michael Angelo Buonarroti: Sculptor, Painter, Architect. The Story of his Life and Labours. By CHARLES CHRISTOPHER BLACK, M.A. Illustrated with Twenty Woodbury Types. Medium 8vo, cloth extra, gilt. 31*s*. 6*d*.

History of the English People. By the Rev. J. R. GREEN, M.A. With Coloured Maps, Genealogical and Chronological Tables. Crown 8vo. 8*s*. 6*d*.

Michelet's Modern History. Translated from the French. With Continuation to the Present Time. By M. C. M. SIMPSON. Crown 8vo. 4*s*. 6*d*.

Scandinavian History. By E. C. Otté. With Maps. Globe 8vo. 6*s*.

The Harbour Bar. A Tale of Scottish Life. Two Vols. Crown 8vo. 21*s*.

Speaking Likenesses. By Christina Rossetti. With Illustrations By ARTHUR HUGHES. Crown 8vo. 4*s*. 6*d*.

*For the King's Dues. By Agnes Mac*DONELL, Author of "Martin's Vineyard." Crown 8vo. 10*s*. 6*d*. [Next week.

Govinda Samanta; or, the History of a Bengal Raiyat. By the Rev. LAL BEHARI DAY. Two vols. Crown 8vo. 21*s*.

The Princess of Silverland, and other Tales. By ELSIE STRYVELINE. With Frontispiece by Sir NOEL PATON. Globe 8vo. gilt. 4*s*. 6*d*.

New and Cheaper Edition. In One Vol. 8vo.

History of Ancient Philosophy. By the Rev. W. ARCHER BUTLER, late Professor of Moral Philosophy in the University of Dublin. Edited by W. HEPWORTH THOMPSON, D.D., Master of Trinity College, Cambridge. (Revised by the Editor). 12*s*.

*Pharmacographia. A History of the Prin*cipal Drugs of Vegetable Origin, found in Commerce in Great Britain and British India. By F. A. FLÜCKIGER and D. HANBURY, F.R.S. 8vo. 18*s*. [Next week.

The Elements of the Psychology of Cognition. By ROBERT JARDINE, B.D., D.Sc., Principal of the General Assembly's College, Calcutta. Crown 8vo. 6*s*. 6*d*.

Laocoon. Translated from the Text of LESSING, with Notes by the Right Hon. Sir ROBERT J. PHILLIMORE, D.C.L., Judge of the High Court of Admiralty, &c. 8vo. 12*s*.

The Extant Odes of Pindar. Translated into English, with an Introduction and Short Notes by ERNEST MYERS, M.A., Fellow of Wadham College, Oxford. Crown 8vo. 5*s*.

Social Life in Greece, from Homer to Menander. By the Rev. J. P. MAHAFFY, M.A., Fellow of Trinity College, Dublin. Crown 8vo. 7*s*. 6*d*.

A Theory about Sin in Relation to some Facts of Daily Life. Lent Lectures on the Seven Deadly Sins. By the Rev. ORBY SHIPLEY, M.A. Crown 8vo. 7*s*. 6*d*. [This day.

Catholic Reform. By Father Hyacinthe. Letters, Fragments, and Discourses. Translated by MDME. HYACINTHE LOYSON. With a Preface by the Very Rev. A. P. STANLEY, D.D., Dean of Westminster. Crown 8vo. 7*s*. 6*d*.

The Imitation of Christ. By Thomas Kempis. Translated with Preface by W. BENHAM, D.D., Vicar of Margate. Printed with Borders in the Ancient Style after Holbein, Dürer, and other Old Masters, containing Dances of Death, Acts of Mercy, Emblems, &c., and a Variety of Curious Ornamentation. Crown 8vo. 7*s*. 6*d*.

Chatterton: a Story of the Year 1770. By Prof. MASSON, LL.D. Crown 8vo. 5*s*.

The Three Devils: Luther's, Milton's, and Goethe's; and other Essays. By Prof. MASSON, LL.D. Crown 8vo. 5*s*.

The Common Frog. By St. George Mivart, F.R.S., &c. Lecturer on Comparative Anatomy at St. Mary's Hospital. With numerous Illustrations. (NATURE SERIES.) 3*s*. 6*d*.

Polarisation of Light. By W. Spottiswoode, LL.D., F.R.S. With numerous Illustrations. Crown 8vo. (NATURE SERIES.) 3*s*. 6*d*.

On British Wild Flowers considered in relation to Insects. By Sir JOHN LUBBOCK, M.P., F.R.S. Crown 8vo. (NATURE SERIES.) 3*s*. 6*d*.

Primer of Astronomy. By J. Norman LOCKYER, F.R.S. With Illustrations. 18mo. (MACMILLAN'S SCIENCE PRIMERS.) 1*s*.

Essays on Shakespeare. By Karle Elze, Ph.D. Translated, with permission of the Author, by L. DORA SCHMITZ. 12*s*.

MACMILLAN AND CO., LONDON.

THIS DAY, IN OCTAVO, PRICE 21*s.*

CAVE-HUNTING:

RESEARCHES ON THE EVIDENCE OF CAVES RESPECTING THE EARLY INHABITANTS OF EUROPE.

BY W. BOYD DAWKINS, M.A., F.R.S., &c.,

CURATOR OF THE MUSEUM AND LECTURER IN GEOLOGY IN THE OWENS COLLEGE, MANCHESTER.

With Coloured Plate and Woodcuts.

CONTENTS.

CHAPTER I.—INTRODUCTION.
,, II.—PHYSICAL HISTORY OF CAVES.
,, III.—HISTORIC CAVES IN BRITAIN.
,, IV.—CAVES USED IN THE AGES OF IRON AND BRONZE.
,, V.—CAVES OF THE NEOLITHIC AGE.
,, VI.—THE RANGE OF NEOLITHIC DOLICHO-CEPHALI AND BRACHY-CEPHALI.
,, VII.—CAVES CONTAINING HUMAN REMAINS OF DOUBTFUL AGE.
,, VIII.—THE PLEISTOCENE CAVES OF GERMANY AND GREAT BRITAIN.
,, IX.—THE INHABITANTS OF THE CAVES OF NORTH-WESTERN EUROPE, AND THE EVIDENCE OF THE FAUNA AS TO THE ATLANTIC COAST-LINE.
CHAPTER X.—THE FAUNA OF THE CAVES OF SOUTHERN EUROPE, AND THE EVIDENCE AS TO THE MEDITERRANEAN COAST-LINE IN THE PLEISTOCENE AGE.
,, XI.—THE EUROPEAN CLIMATE IN THE PLEISTOCENE AGE.
,, XII.—CONCLUSION.

APPENDIX I.—ON THE INSTRUMENTS AND METHODS OF CAVE-HUNTING.
,, II.—OBSERVATIONS ON THE ACCUMULATION OF STALAGMITE IN THE INGLEBOROUGH CAVE.

MACMILLAN AND CO., LONDON.

THE BREWERS' GUARDIAN:

A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.

REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.

The Official Organ of the Country Brewers' Society.
(Founded 18[illegible])

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests. Subscription, 16*s.* 6*d.* per annum, post free, dating from any quarter-day. Single Copies, 1*s.* each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

This day is published, price 1*s.* 6*d.*

MODERN SCIENCE AND NATURAL RELIGION.

An Essay read before the
CHURCH CONGRESS AT BRIGHTON,
And now submitted to
THE MEMBERS OF THE BRITISH ASSOCIATION
Who listened to the Presidential Address at Belfast.

BY REV. C. PRITCHARD, M.A. F.R.S. F.G.S.

Oxford and London: JAMES PARKER & CO.
Cambridge: DEIGHTON & BELL.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR OCTOBER 1874.
WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,
REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.
Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF OCTOBER NUMBER.—Our Illustrations:—1. Gibson's "Venus," from the Original Study. 2. Fresco by Correggio. 3. "Hope," by Puvis De Chavannes.—Foley's Place among British Sculptors.—The Revised Theory of Light, by W. Cave Thomas, No. 2.—The Golden Wedding of Mr. and Mrs. S. C. Hall.—Art Notes and Gossip.—The Decoration of St. Paul's Cathedral (Letter No. 4.)

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

E. DENT & CO., 61, Strand, & 34, Royal Exchange
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), COMPASSES, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED
PATENT CISTERN FILTERS, CHARGED SOLELY WITH ANIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Frankland's reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, January 12, 1867. Also Testimonials from Dr. Hassall, September 23, 1863; Dr. Lankester, September 10, 1867; Dr Letheby, February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.

Portable Cistern Filter.

Price £1 10s and upwards Portable Filters on this system, £1 5s. to £3.
Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham, by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10s 6d. and 21s. each.
Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DREW on the Preliminary Duties of Health Officers.
Pocket Filters from 4s. 6d to 6s. each. Household and Fancy Filters from 12s. 6d.
The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,
157, STRAND, W.C. (Four Doors from Somerset House), LONDON.
Read "Water: its Impurities and Purification," price, per post, 2d.
NOW READY.

AGRICULTURAL PUBLICATIONS.

THE PROPORTIONATE FATTENING and FLESH-FORMING QUALITIES of nearly all the FEEDING SUBSTANCES in general use by Farmers: also the Manurial Value of the Residue from each article.

Opinions of the Press.

"It is clearly a very useful indicator of the values of the foods for cattle."—*Athenæum.*

"The chart cannot fail to be very useful to the keepers of horses and neat-stock, and it will be an 'eye-opener' to many who will perceive how it is they have been so often disappointed, after giving large prices for fancy foods."—*Sporting Times.*

"A very useful table. The system is a very capital one, and we recommend our agricultural friends to invest a shilling, and procure one of the tables published by the Agricultural and Horticultural Association."—*Land and Water.*

Price One Shilling, Post Free.

THE AGRICULTURAL ECONOMIST. A Monthly Journal, containing Reports and Prices Current of the Agricultural and Horticultural Association, and devoted to the advocacy and encouragement of Co-operation in Agriculture and in general Trading. Price 6d. per month, or 5s. per annum, post-free.
Vols. I., II., and III. of the "Agricultural Economist" for 1870, 1871, and 1872, price 7s. 6d. each.

PREPARING FOR PUBLICATION (*Second Edition*).

THE MINERAL CONSTITUENTS REMOVED from an ACRE of SOIL, by an Average Crop of Wheat, Oats, Barley, Turnips, &c.; also the Proportionate Refertilising Effects of Guano, Superphosphates, Potash, Salts, Farmyard Manure, &c. Price One Shilling post free.

London: 176, FLEET STREET, E.C., and 47, MILLBANK STREET, S.W.

"MAZELINE" GOLD JEWELLERY.
(*Catalogue post free.*)

18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c. gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s. to 45s Alberts, 2s. to 5s.; Long Chains, 5s. to 8s 6d.; Lockets, 2s to 5s. 6d.; Crosses, 1s. 6d. to 4s. 6d; Ladies' Gem Rings, 2s. to 5s.; Wedding and Keeper Rings, 1s to 2s. 6d; Gents' Finger Rings, 2s. 6d. to 6s.; Bracelets, 5s to 10s 6d.: Studs, 1s. to 3s. 6d.; Links, 1s to 3s; Breast Pins, 1s to 4s 6d, Brooches, 1s. 6d to 7s. 6d; Ear Rings, 1s 6d to 6s. 6d.; Sets (*en suite*), Brooch and Ear Rings, 5s 6d to 10s 6d.; Pencil Cases, 2s. to 4s 6d., Gents' Snake Rings (Plain Head), 3s. 6d, Head set with Brilliant, &c, 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years. Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "MAZELINE" GOLD JEWELLERY to be obtained of
MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.
P O O to be made payable at Post Office, Bishopsgate Street Without, London, E C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published by MACMILLAN & Co., at the Office 29 and 30, Bedford Street, Covent Garden.—THURSDAY, October 15, 1874.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 260, Vol. 10] THURSDAY, OCTOBER 22, 1874 [Price Fourpence

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

UNIVERSITY COLLEGE, LONDON.

The PROFESSORSHIP of COMPARATIVE ANATOMY and ZOOLOGY is VACANT through the death of Dr GRANT. Candidates for the appointment are requested to send their Applications and Testimonials to the undersigned, from whom further information may be obtained, on or before SATURDAY, OCTOBER 31.

JOHN ROBSON, B.A, Secretary to the Council

VACANT. — The PROFESSORSHIP of NATURAL HISTORY at the Agricultural College, Cirencester. The Professor will have to lecture on Botany and Geology, and to assist in the discipline of the College. The duties will commence in the second week of February 1875 —Apply to the Rev the Principal

LADIES' EDUCATIONAL ASSOCIATION, in connection with University College, London —The Day Classes for Ladies, of English, French, and Italian Languages and Literature, Logic (elementary and advanced), Constitutional History, and Chemistry, will open at University College on and after MONDAY, Oct. 26. Prospectuses to be had at the Office in the College, or of J. E. Mylne, Esq., 27, Oxford Square, Hyde Park, W.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr. Angus Smith, F.R.S.; Dr. Tyndall, F.R.S.; Dr. Voelcker, F.R.S.; Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.— The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof E. V. Gardner, F.E.S., F.S.A., 44, Berners Street, W.

PRELIMINARY EXAMINATIONS of the COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr J. ERLE BENHAM (formerly of King's College, London, author of several works) who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c, address to 3, Pump Court, Temple, or to the care of Messrs Butterworth, 7, Fleet Street, her Majesty's Publishers.

Mr. C. H. LAKE (Graduate in Honours, London) receives a limited number of RESIDENT PUPILS. Testimonials from the late J. S. Mill, Dr. Tyndall, &c. Science receives careful attention.—Withernden, Caterham, Surrey.

As LECTURER on TECHNOLOGICAL CHEMISTRY —A Gentleman with long experience in Technological Chemistry acquired in various chemical manufactories, where the positions of analyst, scientific and practical manager and partner, have been held at different times, wishes to obtain a LECTURESHIP as above, either in some existing institution, or as a commencement on trial, accompanied with some definite guarantee Instruction in the Laboratory in Technical Analyses and in the art of Chemico-technological Research would be undertaken, also in the general method and rules to be observed in laying down plant, and generally in preparing plans and specifications for chemical works. The advertiser would also undertake, if desired, a Supplementary Course of Instruction in pure Chemistry, accompanied with Laboratory Practice.—Apply by letter to F. C S., Post Office, Alderley, Cheshire

PREPARATION for the Public Schools by an Oxford M.A and First Classman. Natural Science included in the ordinary scheme of work.—Address J. L. Watson, Esq, Richmond House, Worthing, Sussex.

TUITION in CLASSICS, ENGLISH LANGUAGE, HISTORY, and LITERATURE.—An experienced Tutor attends Schools and Families, in London or the Country, to teach the above Subjects Prepares for the Public Schools, Universities, and the Army —Address Tutor, 15, Gledhow Terrace, South Kensington, S.W.

SCIENTIFIC and LITERARY SOCIETIES requiring ROOMS for MEETINGS, REFRESHMENT, &c, may hear of excellent Accommodation at a Moderate Cost by applying to Mr. Poole, 11, Chandos Street, Cavendish Square, W.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, Cambridge, receives several Pupils, to prepare for the Universities and other examinations; and has now Vacancies

SCIENCE TUITION by CORRESPONDENCE —For terms, apply to D C L, care of Macmillan and Co, 29, Bedford Street, Strand, London, W.C.

PRIVATE TUITION.—A Clergyman of long experience and uniform success in Tuition, RECEIVES FOUR PUPILS Home comforts combined with great educational advantages. The highest references —M A., care of Editor of Nature, 29, Bedford Street, Strand, W.C.

ASTRONOMER.—Wanted, a Young Gentleman as Assistant in a Private Observatory in Ireland. He must be a good mathematician, and if possible, a German scholar Terms, £50 a year, with board and lodging.—For full particulars apply to W, Post Office, Edgeworthtown, Ireland.

NOTICE OF REMOVAL.—Mr. JAMES R. GREGORY, Geologist, will REMOVE in DECEMBER NEXT to extensive and well-lighted Premises, now building at 88, CHARLOTTE STREET, FITZROY SQUARE, W., from 15, Russell Street, Covent Garden. Collections and Specimens as usual.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells Geological Maps, Hammers, all the Recent Publications, &c, of J TENNANT, Mineralogist to Her Majesty 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F.R.G.S, at his residence, 149, Strand, W.C.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 25s.; 200 ditto, £2 10s to £3 10s.; 300 ditto, £4 10s. to £6; 400 ditto, £6 to £8; 500 ditto, £8 8s. to £10 10s. Including Half Fossils, 250 Examples, £3 10s. 6d., 400 ditto, £6. 150 FOSSILS Illustrating Morris's Chart or Lyell's Manual, 30s; 250 ditto (mostly of the species figured), £3; 350 ditto, £5 to £6 RECENT SHELLS: 100 genera, £1; 200 ditto, £2 10s.

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

The Half. Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS, BREWERS, STOCKWELL.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV. From 10s each. SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d.—SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

THE ZOOLOGIST:

A MONTHLY JOURNAL OF NATURAL HISTORY,

Conducted by EDWARD NEWMAN, F.L.S F.Z.S. &c.

The Zoologist was established in 1843 to record and preserve observations on subjects similar to those treated of in White's "Natural History of Selborne," and the success which has attended it is sufficient proof that its plan is acceptable to "out-of-door naturalists," those who delight in observing the manners, habits, the private lives, the migrations, movements, nests, young and food of animals. It contains original papers and records of facts relating to Quadrupeds, Birds, Reptiles, Fishes, and Insects, together with notices of recent works on every branch of Natural History. The editor has been assisted by more than two hundred of our very best zoologists.

Published on the First of every Month.

PRICE ONE SHILLING.

London: JOHN VAN VOORST, 1, Paternoster Row.

THE EDINBURGH REVIEW, No. 286,

OCTOBER, is just published

CONTENTS.

I.—"Scharnhorst."
II.—"The Book of Carlaverock."
III.—"English Fugitive Songs and Lyrics."
IV.—"Census of France in 1872."
V.—"Comets and Meteors."
VI.—"Convocation, Parliament, and the Prayer Book."
VII.—"The Grenadier Guards."
VIII.—"Renan's Antichrist."
IX.—"Mr. Charles Greville's Journals."
X.—"The Session and the Ministry."

London: LONGMANS & CO. Edinburgh: A. & C. BLACK.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,

BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B, F.L.S, British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12s. post free in the United Kingdom) payable in advance to the publishers, Messrs Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16s. 6d. bound in cloth): also covers for the volume (price 1s.), and back numbers.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U S.A.

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences.

6d. MONTHLY, or POST-FREE, 6s. 6d. PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—

The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions.
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

*** This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL

AND FARMERS' CHRONICLE,

Edited by JOHN ALGERNON CLARKE, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3d., or prepaid, 15s. a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 19*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, W.C.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations,

Conducted by J. W. DOUGLAS, R. MCLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10*s.* each; the succeeding vols. may be had separately or together at 7*s.* each.

London: JOHN VAN VOORST, 1, Paternoster Row.

N.B.—Communications, &c., should be sent to the Editors at the above address.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

"*NATURE.*"

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

W. LADD & CO.

SCIENTIFIC INSTRUMENT MANUFACTURERS

(By Appointment to the Royal Institution of Great Britain).

Spectroscopes, Microscopes, Polariscopes, and every variety of Philosophical Apparatus.

11 & 12, BEAK STREET, REGENT STREET, W.,

AND

199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS

is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided, a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,

JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16*s.*, 21*s.*, 26*s.* 6*d.*, and 31*s.* 6*d.*
" Double " 31*s.* 6*d.*, 42*s.*, and 52*s.* 6*d.*
" Umbilical " 42*s.* and 52*s.* 6*d.*
} Post-free.

ELASTIC STOCKINGS, KNEE-CAPS,

&c., for Varicose Veins and all cases of weakness and Swellings of the Legs, Sprains, &c. They are porous, light in texture, and inexpensive, and drawn on over an ordinary stocking. Price 4*s.* 6*d.*, 7*s.* 6*d.*, 10*s.*, and 16*s.* each. Postage free.

JOHN WHITE, Manufacturer, 228, Piccadilly, London.

JUDSON'S DYES.—18 Colours, 6d. each.

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c.—Much trouble may be saved in grinding up colours to a uniform tint. They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 11 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off. They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

NEXT WEEK, medium 8vo. price 21*s.*

DEEP-SEA FISHING AND FISHING-BOATS.

An Account of the Practical Working of the various Fisheries around the British Islands; with Illustrations and Descriptions of the Boats, Nets, and other Gear in use.

BY EDMUND W. H. HOLDSWORTH, F.L.S., F.Z.S., &c.,

LATE SECRETARY TO THE ROYAL SEA FISHERIES COMMISSION.

London: EDWARD STANFORD, 67 AND 68, CHARING CROSS, S.W.

MUTUAL LIFE ASSURANCE.

SCOTTISH PROVIDENT INSTITUTION,

Established 1837.

6, ST. ANDREW SQUARE, EDINBURGH; 18, KING WILLIAM STREET, LONDON, E.C.

The FOURTH DIVISION OF PROFITS has been recently made. The investigation, conducted upon the safest estimates, showed a surplus of £376,000; of which the sum of £251,500 was divided among the Policy-holders. The number entitled to participate in terms of the laws was 4,599, and the result was that policies, say for £1,000 sharing for the *first* time, were increased to sums ranging from £1,170 to £1,300. The increase to policies which had before participated was proportionally greater. In a few cases Policies which have shared at the whole *four* divisions have now been doubled.

The Directors invite attention to the principles of the Institution. It is the only office in which the advantage of participation in profits can be obtained on moderate terms; while from the principle on which these are distributed, Policies may eventually receive as large additions as in offices charging the usual high rates.

The premiums are at many ages twenty or twenty-five per cent. lower than in the other Scottish Mutual offices. For example, a Policy of £1,200 to £1,250 may, at ages 30 to 40, be received *from the first* for the same yearly payment, which in these would assure £1,000 only.

The FUND now exceeds £2,300,000. Notwithstanding its low premiums, no office of the same age in the kingdom has so large a fund.

In all points of ADMINISTRATION the rules will be found peculiarly favourable to the assured, in whose interests alone they have been framed.

Copies of the Thirty-sixth Annual Report may be had on application at the offices.

JAMES WATSON, Manager.
J. MUIR LEITCH, London Sec.

Just published, price 1*s.*

Rev. Dr. James Martineau.—RELIGION as AFFECTED by MODERN MATERIALISM.—An Address delivered in Manchester (New) College, London, at the opening of its 89th Session, Oct. 6, 1874. By JAMES MARTINEAU, LL.D., Principal.

WILLIAMS & NORGATE, 14, Henrietta Street, Covent Garden, London, and 20, South Frederick Street, Edinburgh.

Dr. Russell Reynolds' SYSTEM of MEDICINE. In 8vo, price 25*s.* each.

Vol. I.—GENERAL DISEASES: or, Affections of the Whole System. Second Edition.
Vol. II.—DISEASES of the NERVOUS SYSTEM and of the STOMACH. Second Edition.
Vol. III.—DISEASES of the DIGESTIVE SYSTEM (continued); Diseases of the Mouth; Diseases of the Respiratory System.
Vol. IV.—DISEASES of the CIRCULATORY SYSTEM, the Blood-Glandular, the Urinary, the Reproductive, and Cutaneous Systems. [*In preparation.*

MACMILLAN & CO., London.

Now ready, Fifth Edition, considerably Extended, with 40 Wood Engravings, Frontispiece, and 8 new Panoramic Maps, post 8vo, 12*s.* 6*d.*

WINTER and SPRING on the SHORES of the MEDITERRANEAN; or the Rivieras, Italy, Spain, Greece, Constantinople, the Archipelago, Corsica, Sicily, Sardinia, Algeria, Tunis, Smyrna, with Biarritz and Arcachon, as Winter Climates.

By DR. HENRY BENNET.

J. & A. CHURCHILL, New Burlington Street.

LONDON AND CHILWORTH.

MESSRS. UNWIN BROTHERS, Printers and Stereotypers, are prepared to undertake Two or Three Periodicals; also High-class Bookwork in Ancient or Modern Style, with appropriate Ornaments. Having both Country and London Offices, special facilities can be offered. Estimates on application to 1, 2, and 3, Oxford Court (109A, Cannon Street), E.C.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative 16 Plates, 10*s.* 6*d.* Now ready, Third Edition. J. & A. CHURCHILL.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6*s.* 6*d.* J. & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12*s.* 6*d.* J. & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS. Third Edition, 25*s.* J. & A. CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3*s.* 6*d.* J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition much enlarged. J. & A. CHURCHILL. [In the Press
7. HOW to WORK with the MICROSCOPE. 21*s.* HARRISON, Pall Mall.

In crown 8vo, with 49 Diagrams, price 6*s.*

BRINKLEY'S ASTRONOMY, revised and partly rewritten, with Additional Chapters, and an Appendix of Questions for Examination. By JOHN WILLIAM STUBBS, D.D., Fellow and Tutor of Trinity College, Dublin; and FRANCIS BRUNNOW, Ph.D., Astronomer Royal of Ireland, and Professor of Astronomy in the University of Dublin. Second Edition, enlarged and improved.

London: LONGMANS & CO.

NEW WORKS BY THE REV. J. G. WOOD, M.A.

Author of "Homes Without Hands," &c.

OUT of DOORS: a Selection of Original Articles on Practical Natural History, uniform with "Strange Dwellings" by the same Author; with 6 Illustrations from Original Designs engraved on Wood by G. Pearson. Crown 8vo, price 7*s.* 6*d.* cloth. [On Nov. 2.

INSECTS ABROAD: a Popular Account of Foreign Insects, their Structure, Habits, and Transformations. With 600 Figures by E. A. Smith and J. B. Zwecker, engraved on Wood by G. Pearson. Forming a Sequel or Companion Volume to "Insects at Home" by the same Author. 8vo, price 21*s.* cloth. [On Nov. 2.

London: LONGMANS & CO.

Just published.

SEVEN LIFE-SIZED DIAGRAMS of the HUMAN BODY. By JOHN MARSHALL, F.R.S. F.R.C.S., Professor of Anatomy to the Royal Academy. Designed expressly for Artists and Art Schools. Price 12*s.* 6*d.* each.

ELEVEN LIFE-SIZED PHYSIOLOGICAL DIAGRAMS of the HUMAN BODY. By JOHN MARSHALL, F.R.S. F.R.C.S., Professor of Surgery to University College. An entirely new edition, revised and extended. Price 12*s.* 6*d.* each Sheet, coloured on paper, 7 ft. 3 in. by 3 ft. 9 in.

NINE BOTANICAL DIAGRAMS, by Professor HENSLOW, for the use of Lecturers, Schools, &c. Price £2 the set.

Prospectuses of the above Works on application.

London: ALFRED TARRANT, 11, Serle Street, W.C.; CHAPMAN & HALL, Piccadilly, and all Booksellers.

DIARY OF SOCIETIES.

LONDON

THURSDAY, OCTOBER 22.

JUNIOR PHILOSOPHICAL SOCIETY, at 7 30.—Principles of Art: J. R. Hilder.

FRIDAY, OCTOBER 23.

QUEKETT MICROSCOPICAL CLUB, at 8.—On cutting Sections of the Eyes of Insects, and on a New Instrument for that purpose: R. P. Williams.

LEEDS

TUESDAY, OCTOBER 27

NATURALISTS' FIELD CLUB AND SCIENTIFIC ASSOCIATION, at 8.—Solar Physics: John Garbutt, F.R.A.S.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in NATURE of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of NATURE *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

OFFICE—29, BEDFORD STREET, STRAND.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	*s.*	*d.*
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

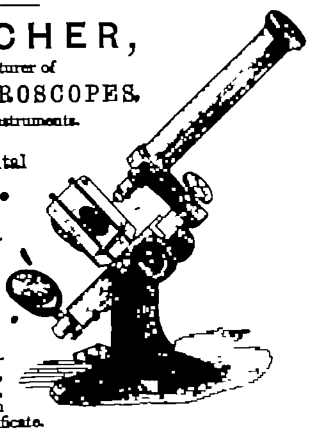
Post-office Orders payable to MACMILLAN & CO.

OFFICE: BEDFORD STREET, STRAND, W.C.

BRYANT & MAY'S
MATCHES.

INTERNATIONAL EXHIBITION
PRIZE MEDAL AWARDS,
London, 1851. Paris, 1855. London, 1862. Vienna, 1873.
FOR EXCELLENCE AND CHEAPNESS.

M. PILLISCHER,
Optician and Manufacturer of
ACHROMATIC MICROSCOPES,
and all kinds of Scientific Instruments.



Pillischer's
St. Thomas's Hospital
Microscope,
As supplied to the principal Universities and Hospitals.
Monocular, £5; Binocular, £10 10*s.*

PILLISCHER'S New Series of Correction and Immersion Object-glasses, from ¼ to 1/16 inch, unequalled for their brilliant Defining and Penetrating Power.

PILLISCHER'S Improved CLINICAL THERMOMETERS, in Sterling Silver Cases, 3½ in., 14*s.*; 4½ in., 17*s.*; 6 in., in Wooden Case, 10*s.*, including a Kew Certificate.

ILLUSTRATED DESCRIPTIVE CATALOGUE MAY BE HAD ON APPLICATION TO,
88, New Bond Street, W., London.

TISLEY'S PENDULUM APPARATUS.

With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet	£12	0	0
Reflectors for projecting the Figures on the Screen	2	12	6
N.B.—Specimen Curves, on card, post free ... per dozen	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3	0	7	0
Ditto traced on blackened Glass, for the Lantern ... per slide	0	3	6
New Set of Acoustic Apparatus	5	5	0
Improved Ozone Generators ... **21s. &**	3	3	0
Pocket Spectroscopes, with new Slit Adjustment	1	5	0

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD,
(Three minutes' walk from South Kensington Museum)

THE BREWERS' GUARDIAN:
A Fortnightly Paper devoted to the Protection of Brewers' Interests, Licensing, Legal, and Parliamentary Matters.
REVIEW OF THE MALT AND HOP TRADES; AND WINE AND SPIRIT TRADES RECORD.
The Official Organ of the Country Brewers' Society.
(Founded 1822.)

"The Brewers' Guardian" is published on the Evenings of every alternate Tuesday, and is the only journal officially connected with brewing interests. Subscription, 16*s.* 6*d.* per annum, post free, dating from any quarter-day. Single Copies, 1*s.* each. Registered for transmission abroad.

Offices—5, Bond Court, Walbrook, London, E.C.

HOLLOWAY'S OINTMENT and PILLS.—At the present time much watchfulness must be exercised, and the earliest evidences of ill-health immediately checked, or a slight illness may result in a serious malady. Relaxed and sore throat, diphtheria, quinsey, coughs, chronic cough, bronchitis, and most other pulmonary affections will be greatly relieved by rubbing this cooling Ointment into the skin as nearly as practicable to the seat of mischief. This treatment, at once simple and effective, is admirably adapted for the removal of such diseases during infancy and youth. Old asthmatic invalids will derive marvellous ease from the use of Holloway's remedies, which have brought round many such sufferers, and re-established health after every other means had signally failed.

THIS DAY, IN OCTAVO, PRICE 21s.

CAVE-HUNTING:

RESEARCHES ON THE EVIDENCE OF CAVES RESPECTING THE EARLY INHABITANTS OF EUROPE.

BY W. BOYD DAWKINS, M.A., F.R.S., &c.,

CURATOR OF THE MUSEUM AND LECTURER IN GEOLOGY IN THE OWENS COLLEGE, MANCHESTER.

With Coloured Plate and Woodcuts.

CONTENTS.

Chapter I.—Introduction.
„ II.—Physical History of Caves.
„ III.—Historic Caves in Britain.
„ IV.—Caves used in the Ages of Iron and Bronze.
„ V.—Caves of the Neolithic Age.
„ VI.—The Range of Neolithic Dolicho-Cephali and Brachy-Cephali.
„ VII.—Caves containing Human Remains of Doubtful Age.
„ VIII.—The Pleistocene Caves of Germany and Great Britain.
„ IX.—The Inhabitants of the Caves of North-western Europe, and the Evidence of the Fauna as to the Atlantic Coast-line.
Chapter X.—The Fauna of the Caves of Southern Europe, and the Evidence as to the Mediterranean Coast-line in the Pleistocene Age.
„ XI.—The European Climate in the Pleistocene Age.
„ XII.—Conclusion.

Appendix I.—On the Instruments and Methods of Cave-hunting.
„ II.—Observations on the Accumulation of Stalagmite in the Ingleborough Cave.

MACMILLAN AND CO., LONDON.

"NATURE" SERIES.

A SERIES OF POPULAR SCIENTIFIC WORKS.

Vol. I.—The SPECTROSCOPE and its APPLICATIONS. By J. Norman Lockyer, F.R.S. With numerous Illustrations. Second Edition, crown 8vo, 3s. 6d.

"To any student who wishes to make himself, in a comparatively short time, well acquainted with the principles and the application of the spectroscope, we cannot recommend a better treatise."—*Westminster Review.*

Vol. II.—The ORIGIN and METAMORPHOSIS of INSECTS. By Sir John Lubbock, M.P. F.R.S. With numerous Illustrations. Second Edition, crown 8vo, 3s. 6d.

"We invite attention to the admirable manner in which the subject of insect metamorphosis is illustrated by excellent figures." —*Field.*

Vol. III.—The BIRTH of CHEMISTRY. By G. F. Rodwell, F.R.A.S. F.C.S., Science Master in Marlborough College. With numerous Illustrations. Crown 8vo, 3s. 6d.

"Mr. Rodwell's work is the product of scholarly investigation. Chemists cannot fail to enjoy it, and those who are not chemists will be tempted to enter on the study of its mysteries."—*Chemist and Druggist.*

"A thoughtful, suggestive, and decidedly readable work."—*Quarterly Journal of Science.*

The TRANSIT of VENUS. By George Forbes, B.A., Professor of Natural Philosophy in the Andersonian University, Glasgow. With numerous Illustrations. Crown 8vo, 3s. 6d.

To be shortly published.

POLARISATION of LIGHT. By W. Spottiswoode, LL.D. F.R.S. With numerous Illustrations. Crown 8vo.

The COMMON FROG. By St. George Mivart, F.R.S., Lecturer on Comparative Anatomy at St. Mary's Hospital. With numerous Illustrations. Crown 8vo.

On BRITISH WILD FLOWERS, considered in RELATION to INSECTS. By Sir JOHN LUBBOCK, M.P. F.R.S. With numerous Illustrations. Crown 8vo.

MACMILLAN & CO., LONDON.

L. OERTLING,

TURNMILL STREET, NEAR FARRINGDON STREET STATION

(LATE OF 27, MOORGATE STREET, CITY),

MANUFACTURER OF

CHEMICAL, ASSAY, AND BULLION BALANCES.

Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c.

By Appointment.

Hydrometer and Saccharometer Maker to the Board of Inland Revenue.

Council Medal, 1851. *First Class Medal*, 1854 *and* 1862.

"MAZELINE" GOLD JEWELLERY.

(*Catalogue post free.*)

18c. GOLD —Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD —Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining to the last its 18c. gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s to 45s. Alberts, 2s to 5s; Long Chains, 5s. to 8s. 6d.; Lockets, 2s to 5s 6d.; Crosses, 1s 6d. to 4s. 6d.; Ladies' Gem Rings, 2s. to 4s.; Wedding and Keeper Rings, 1s. to 2s. 6d.; Gents' Finger Rings, 2s 6d. to 6s.; Bracelets 5s to 10s. 6d.; Studs, 1s. to 3s. 6d.; Links, 1s to 3s; Breast Pins, 1s to 4s 6d, Brooches, 1s 6d. to 7s 6d, Ear Rings, 1s 6d to 6s 6d.: Sets (*en suite*), Brooch and Ear Rings, 5s. 6d to 10s 6d; Pencil Cases, 2s to 4s 6d.; Gents' Snake Rings (Plain Head), 3s. 6d, Head set with Brilliant, &c, 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, are now enabled to offer and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within the reach of all.

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and charging the same prices; we therefore beg to put the public on their guard against such deceptions.

N.B.—Every watch is guaranteed for two years Names and Addresses should be distinctly and clearly written in full.

Full-priced Catalogues and Press Opinions of the "MAZELINE" GOLD JEWELLERY to be obtained of

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANUFACTURERS,
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.

P O O to be made payable at Post Office, Bishopsgate Street Without, London, E C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS.

NOW READY.

PRICE 1s.

PRIMER OF PHYSIOLOGY.

BY

MICHAEL FOSTER, M.A., M.D., F.R.S.,

FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

With Illustrations.

MACMILLAN & CO., LONDON.

Now Ready. Price One Shilling.

ART

PICTORIAL AND INDUSTRIAL: A REVIEW.

FOR OCTOBER 1874.

WITH CHOICE EXAMPLES FROM VARIOUS SOURCES,

REPRODUCED BY THE HELIOTYPE AND OTHER PERMANENT PROCESSES.

Edited by JOHN FORBES-ROBERTSON.

"ARS ARTIS CAUSÂ, ITAQUE HOMINIS."

CONTENTS OF OCTOBER NUMBER.—Our Illustrations:—1. Gibson's "Venus," from the Original Study. 2. Fresco by Correggio. 3. "Hope," by Puvis De Chavannes.—Foley's Place among British Sculptors.—The Revised Theory of Light, by W. Cave Thomas, No. 2.—The Golden Wedding of Mr. and Mrs. S. C. Hall.—Art Notes and Gossip.—The Decoration of St. Paul's Cathedral (Letter No. 4.)

SPECIAL NOTICE.—The Publishers take the present opportunity of informing the Readers of "Art" that fresh arrangements have been entered into for the reproduction in the forthcoming Numbers of choice examples of Painting, Engraving, Sculpture, Pottery, and Art objects generally. These will be representative both of British and Continental Schools.

N.B.—Artists and those connected with Artistic manufacture wishing their works to be reproduced in the pages of "Art," are requested to communicate with the Editor, through the Publishers.

London: SAMPSON LOW, MARSTON, LOW, & SEARLE, 188, Fleet Street, E.C.

NEW AND FORTHCOMING BOOKS.

BY SIR SAMUEL W. BAKER, PASHA, F.R.S., ETC.

Ismailia: a Narrative of the Expedition to Central Africa for the Suppression of the Slave Trade, organised by Ismail, Khedive of Egypt. With Maps, Portraits, and upwards of Fifty full-page Illustrations by Zwecker and Durand. Two vols. 8vo. 36*s.*

The Russian Power. By Ashton W. Dilke. With Maps and Illustrations. Two vols. Medium 8vo. 32*s.*

Biography of the Right Hon. Francis BLACKBURNE, late Lord Chancellor of Ireland. Chiefly in Relation to his Public and Political Career. By his Son. 8vo. 12*s.*

Lady Duff Gordon's Last Letters from Egypt, to which are added Letters from the Cape. With a Memoir by her Daughter. With Portrait engraved by Jeens after Phillips. Crown 8vo. 9*s.*

A Ramble Round the World, 1871. *By* M. LE BARON DE HÜBNER, formerly Ambassador and Minister. Translated by Lady Herbert. Two vols. 8vo. 25*s.* [Next week.

Outlines of Cosmic Philosophy, based on the Doctrine of Evolution, with Criticisms on the Positive Philosophy. By JOHN FISKE, M.A., LL.B., formerly Lecturer on Philosophy at Harvard University. Two Vols. 8vo. 25*s.*

Milton's Poetical Works. Edited, with Text Collated from the best Authorities, with Introduction and Notes, by DAVID MASSON, Professor of Rhetoric and English Literature in the University of Edinburgh. With Three Portraits engraved by C. H. Jeens and Radcliffe. Three vols. 8vo. (Uniform with the Cambridge Shakespeare.) 42*s.*

Milton's Poetical Works (Golden Treasury Edition). With Introduction and Notes, by Professor MASSON. With Two Portraits engraved by Jeens. Two vols. 18mo. 9*s.*

Michael Angelo Buonarroti: Sculptor, Painter, Architect. The Story of his Life and Labours. By CHARLES CHRISTOPHER BLACK, M.A. Illustrated with Twenty Woodbury Types. Medium 8vo, cloth extra, gilt. 31*s.* 6*d.*

History of the English People. By the Rev. J. R. GREEN, M.A. With Coloured Maps, Genealogical and Chronological Tables. Crown 8vo. 8*s.* 6*d.*

Michelet's Modern History. Translated from the French. With Continuation to the Present Time. By M. C. M. SIMPSON. Crown 8vo. 4*s.* 6*d.*

Scandinavian History. By E. C. Otté. With Maps. Globe 8vo. 6*s.*

The Harbour Bar. A Tale of Scottish Life. Two Vols. Crown 8vo. 21*s.*

Speaking Likenesses. By Christina Rossetti. With Illustrations By Arthur Hughes. Crown 8vo. 4*s.* 6*d.*

*For the King's Dues. By Agnes Mac*DONELL, Author of "Martin's Vineyard." Crown 8vo. 10*s.* 6*d.* [Next week.

Govinda Samanta; or, the History of a Bengal Raiyat. By the Rev. LAL BEHARI DAY. Two vols. Crown 8vo. 21*s.*

The Princess of Silverland, and other Tales. By ELSIE STRYVELINE. With Frontispiece by Sir Noel Paton. Globe 8vo. gilt. 4*s.* 6*d.*

New and Cheaper Edition. In One Vol. 8vo.

History of Ancient Philosophy. By the Rev. W. ARCHER BUTLER, late Professor of Moral Philosophy in the University of Dublin. Edited by W. Hepworth Thompson, D.D., Master of Trinity College, Cambridge. (Revised by the Editor). 12*s.*

Pharmacographia. A History of the Principal Drugs of Vegetable Origin, found in Commerce in Great Britain and British India. By F. A. FLUCKIGER and D. HANBURY, F.R.S. 8vo. 18*s.* [Next week.

The Elements of the Psychology of Cognition. By ROBERT JARDINE, B.D., D.Sc., Principal of the General Assembly's College, Calcutta. Crown 8vo. 6*s.* 6*d.*

Laocoon. Translated from the Text of LESSING, with Notes by the Right Hon. Sir ROBERT J. PHILLIMORE, D.C.L., Judge of the High Court of Admiralty, &c. 8vo. 12*s.*

The Extant Odes of Pindar. Translated into English, with an Introduction and Short Notes by ERNEST MYERS, M.A., Fellow of Wadham College, Oxford. Crown 8vo. 5*s.*

Social Life in Greece, from Homer to Menander. By the Rev. J. P. MAHAFFY, M.A., Fellow of Trinity College, Dublin. Crown 8vo. 7*s.* 6*d.*

A Theory about Sin in Relation to some Facts of Daily Life. Lent Lectures on the Seven Deadly Sins. By the Rev. ORBY SHIPLEY, M.A. Crown 8vo. 7*s.* 6*d.* [This day.

Catholic Reform. By Father Hyacinthe. Letters, Fragments, and Discourses. Translated by Mdme. Hyacinthe Loyson. With a Preface by the Very Rev. A. P. Stanley, D.D., Dean of Westminster. Crown 8vo. 7*s.* 6*d.*

The Imitation of Christ. By Thomas Kempis. Translated with Preface by W. Benham, D.D., Vicar of Margate. Printed with Borders in the Ancient Style after Holbein, Dürer, and other Old Masters, containing Dances of Death, Acts of Mercy, Emblems, &c., and a Variety of Curious Ornamentation. Crown 8vo. 7*s.* 6*d.*

Chatterton; a Story of the Year 1770. By Prof. MASSON, LL.D. Crown 8vo. 5*s.*

The Three Devils: Luther's, Milton's, and Goethe's; and other Essays. By Prof. MASSON, LL.D. Crown 8vo. 5*s.*

The Common Frog. By St. George Mivart, F.R.S., &c. Lecturer on Comparative Anatomy at St. Mary's Hospital. With numerous Illustrations. (Nature Series.) 3*s.* 6*d.*

Polarisation of Light. By W. Spottiswoode, LL.D., F.R.S. With numerous Illustrations. Crown 8vo. (Nature Series.) 3*s.* 6*d.*

On British Wild Flowers considered in relation to Insects. By Sir JOHN LUBBOCK, M.P., F.R.S. Crown 8vo. (Nature Series.) 3*s.* 6*d.*

Primer of Astronomy. By J. Norman LOCKYER, F.R.S. With Illustrations. 18mo. (Macmillan's Science Primers.) 1*s.*

Essays on Shakespeare. By Karle Else, Ph.D. Translated, with permission of the Author by L. DORA SCHMITZ. 12*s.*

MACMILLAN AND CO., LONDON.

Printed by R. Clay, Sons, & Taylor, at 7 and 8, Bread Street Hill, in the City of London, and published by Macmillan & Co., at the Office 29 and 30, Bedford Street, Covent Garden.—Thursday, October 22, 1874.

Now Ready, the NOVEMBER number of

THE PRACTITIONER:

A JOURNAL OF THERAPEUTICS AND PUBLIC HEALTH.

EDITED BY

T. LAUDER BRUNTON, M.D., F.R.S.

MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS;
CASUALTY PHYSICIAN TO ST. BARTHOLOMEW'S HOSPITAL; AND LECTURER ON MATERIA MEDICA AND THERAPEUTICS IN ST. BARTHOLOMEW'S HOSPITAL SCHOOL.

PRICE 1s. 6d. MONTHLY.

THE PRESENT NUMBER CONTAINS:—

ORIGINAL COMMUNICATIONS:—
EDITOR'S NOTE.
W. R. BASHAM, M.D.—Nephralgia, Lithuria (Lithiasis), and Oxaluria. Part II.
W. HANDSEL GRIFFITHS, Ph.D., L.R.C.P., L.R.C.S. Edin.—On the Teaching of Materia Medica and Therapeutics.
DR. CLIFFORD ALLBUTT.—The Influence of the Nervous System and of Arsenic upon the Nutrition of the Skin.
ROBERT LAWSON, M.B. Edin.—Neurotic Medicines; with special reference to Camphor and its Monobromide.
SYDNEY RINGER, M.D.—A Successful Case of Traumatic Tetanus treated by large doses of Calabar Bean.
DOUGLAS MORTON, A.M., M.D.—Quinine and Suppuration.
J. MILNER FOTHERGILL, M.D., M.R.C.P.—The Use of Mercury in some of the Obscurer Forms of Syphilis.
JULIUS DRESCHFELD, M.D., L.R.C.P.—On the Use of the Constant Current in Spermatorrhœa.
CLINIC OF THE MONTH.
BIBLIOGRAPHY.
EXTRACTS FROM BRITISH AND FOREIGN JOURNALS.

THE NEW DEPARTMENT OF PUBLIC HEALTH,

CONTAINING THE FOLLOWING ARTICLES:
THE REGISTRAR-GENERAL'S WEEKLY RETURN.
HYGIENIC SOPHISMS.—DR. LETHEBY ON DEATH-RATES.
APPARENT AND REAL CAUSES OF ENTERIC FEVER.

MACMILLAN AND CO., LONDON.

THE ENTOMOLOGIST'S MONTHLY MAGAZINE,

Price Sixpence, monthly, 24 pages 8vo., with occasional Illustrations,

Conducted by J. W. DOUGLAS, R. McLACHLAN, F.L.S., E. C. RYE, and H. T. STAINTON, F.R.S., &c.

This Magazine, commenced in 1864, contains standard articles and notes on all subjects connected with Entomology, and especially on the Insects of the British Isles.

Subscription—Six Shillings per Volume, post-free. The volumes commence with the June number in each year.

Vols. I. to V. (strongly bound in cloth) may be obtained by purchasers of the entire set to date, at the increased price of 10s. each; the succeeding vols. may be had separately or together at 7s. each.

London: JOHN VAN VOORST, 1, Paternoster Row.

[illegible]—Communications, &c., should be sent to the Editors at the above address.

NEWMAN'S ENTOMOLOGIST:

A MONTHLY ILLUSTRATED JOURNAL OF BRITISH INSECTS

Conducted by EDWARD NEWMAN, F.L.S. F.Z.S. &c.,

Late President of the Entomological Society.

The objects of the *Entomologist* are to give every information about Insects; more especially to work out the history of those which attack Fruit and Forest Trees, Vegetables, Root and Seed Crops, Greenhouse and Garden Plants, with a view to suggesting remedies. Notes, Observations, and Queries on every branch of the Science are solicited. To preserve a continuous record of the occurrence of rarities. To improve collections by offering a ready medium for the exchange of specimens.

Published on the First of every Month.

PRICE SIXPENCE.

SIMPKIN, MARSHALL, and Co., Stationers' Hal Court.

THE JOURNAL OF INDUSTRY:

An Illustrated Record of Manufactures, Inventions, and the Applied Arts and Sciences

6d. MONTHLY, or POST-FREE, 6s. 6d. PER ANNUM.

The "Journal of Industry" is issued with the object of promoting the interests of British Manufacturers by—
The Collection of Valuable Information from all parts of the Industrial World.
The Discussion of Matters important to Manufacturers.
Descriptive Accounts of useful Patents and Inventions.
Reports and Correspondence on Science in its Relation to Industrial and Commercial Progress.

*** This Journal has now the Largest Circulation of any Publication of the kind in the World.

Published by WILLIAMS & COMPANY, 7, Bolt Court, Fleet Street, London.

THE

JOURNAL OF APPLIED CHEMISTRY,

A MONTHLY PUBLICATION OF 16 PAGES QUARTO,

Devoted to Chemistry as applied to Arts and Manufactures, Agriculture, Metallurgy, &c. &c.

At Two Dollars and Twenty-five Cents per annum, or One Dollar and Seventy-five Cents paid strictly in advance, including postage to United Kingdom.

Each number contains Original Articles on General Chemistry applied to Arts and Manufactures; Matter on Particular Fabrications, as Petroleum, Soaps, Tanning, Dyeing, and numerous others.

A suitable space is also devoted to Practical Recipes and interesting Scientific Facts.

Full and carefully-prepared Market Reviews and Prices Current of Drugs and Chemicals of every description are given in each number for New York, Boston, and Philadelphia, with Tables of Imports.

EIGHTH VOLUME, commenced with January number.

DEXTER & CO., PUBLISHERS,

17, Spruce Street, New York; 48, Hanover Street, Boston; and 149, South 4th Street, Philadelphia, Pa., U.S.A.

HENRY S. KING & CO.'S LIST.

OBSERVATIONS on MAGNETIC DECLINATION made at TREVANDRUM and AGUSTIA MALLEY in the Observatories of his Highness the MAHARAJAH of TRAVANCORE, G C S I, in the Years 1852 to 1869. Being Trevandrum Magnetical Observations Volume I. Discussed and Edited by JOHN ALLAN BROUN, F.R.S, late Director of the Observatories. With an Appendix. Imperial 4to, cloth, £3 3s.

. The Appendix, containing Reports on the Observatories and on the Public Museum, Public Park, and Gardens at Trevandrum, pp. xii. 116, may be had separately, price 21s.

SENSATION and INTUITION: Studies in Psychology and Æsthetics. By JAMES SULLY, M.A. Demy 8vo, cloth, 10s. 6d.

"As to the manner of the book, Mr Sully writes well, and so as to be understood by anyone who will take the needful pains. . . . The materials furnished by a quick and lively natural sense are happily ordered by a mind trained in scientific method. This method is especially conspicuous in those parts of the book where, with abundant ingenuity and no mean success, Mr. Sully has endeavoured to throw some light of cosmic order into the chaos of æsthetics. Unhappily for our present purpose, the best qualities of the work are precisely those to which we cannot do justice within the limits of a review."—*Saturday Review.*

SECOND EDITION.

The PRINCIPLES of MENTAL PHYSIOLOGY. With their Applications to the Training and Discipline of the Mind, and the Study of its Morbid Conditions. By W. B CARPENTER, LL D. M.D. F.R.S, &c 8vo, illustrated, cloth, 12s.

"This valuable book. . . . Let us add that nothing we have said, or in any limited space could say, would give an adequate conception of the valuable and curious collections of facts bearing on morbid mental conditions, the learned physiological exposition and the treasure-house of useful hints for mental training which make this large and yet very amusing, as well as instructive book, an encyclopædia of well-classified and often very startling psychological experiences."—*Spectator.*

PHYSIOLOGY for PRACTICAL USE. By various writers. Edited by JAMES HINTON. 2 vols. crown 8vo, with 50 Illustrations, cloth, 12s 6d.

"A more clear, valuable, and well-informed set of treatises we never saw than these. . . . And they are pleasant reading, too, as well as useful reading."—*Literary Churchman.*

THE INTERNATIONAL SCIENTIFIC SERIES.

NEW VOLUMES.

ANIMAL MECHANISM. A Treatise on Terrestrial and Aerial Locomotion. By E. J. MAREY, Professor at the College of France, and Member of the Academy of Medicine. Second Edition, crown 8vo, with 117 Illustrations, cloth, 5s.

THE DOCTRINE OF DESCENT AND DARWINISM. By Professor OSCAR SCHMIDT (University of Strassburg). Crown 8vo, illustrated, cloth, 5s. [Immediately.

HENRY S. KING & CO., 65, Cornhill, and 12, Paternoster Row.

MUTUAL LIFE ASSURANCE.

SCOTTISH PROVIDENT INSTITUTION,

Established 1837.

6, ST. ANDREW SQUARE, EDINBURGH; 18, KING WILLIAM STREET, LONDON, E.C.

The FOURTH DIVISION OF PROFITS has been recently made. The investigation, conducted upon the safest estimates, showed a surplus of £376,000; of which the sum of £251,500 was divided among the Policy-holders. The number entitled to participate in terms of the laws was 4,599, and the result was that policies, say for £1,000 sharing for the *first* time, were increased to sums ranging from £1,170 to £1,300. The increase to policies which had before participated was proportionally greater In a few cases Policies which have shared at the whole *four* divisions have now been doubled.

The Directors invite attention to the principles of the Institution. It is the only office in which the advantage of participation in profits can be obtained on moderate terms, while from the principle on which these are distributed, Policies may eventually receive as large additions as in offices charging the usual high rates.

The premiums are at many ages twenty or twenty-five per cent lower than in the other Scottish Mutual offices For example, a Policy of £1,200 to £1,250 may, at ages 30 to 40, be received *from the first* for the same yearly payment, which in those would assure £1,000 only.

The FUND now exceeds £2,300,000 Notwithstanding its low premiums, no office of the same age in the kingdom has so large a fund.

In all points of ADMINISTRATION the rules will be found peculiarly favourable to the assured, in whose interests alone they have been framed.

Copies of the Thirty-sixth Annual Report may be had on application at the offices.

JAMES WATSON, Manager

J. MUIR LEITCH, London Sec.

Lately published, price 15s.

THE UNIVERSAL-PROPORTION TABLE, by Professor J. D. EVERETT, is equivalent to a Slide-rule 13 ft. 4 in long, and can be read to four places of figures. It is printed, from engraved plates, on two folio sheets of card, one of which is cut in gridiron fashion, and is to be laid upon the other The scale is such that a displacement of a third of an inch would only produce an error of one per cent. It is especially adapted to such operations as reducing feet to metres, reducing numbers to percentage of a given number, or in general to changing a set of numbers in any required ratio.

It is accompanied by six folio pages of letterpress, consisting of directions for use, and subsidiary tables

For a fuller description see *Philosophical Magazine*, November 1866.

London: LONGMANS & CO.

NEW WORKS BY THE REV. J. G. WOOD, M.A.

Author of "Homes Without Hands," &c

OUT of DOORS: a Selection of Original Articles on Practical Natural History, uniform with "Strange Dwellings" by the same Author; with 6 Illustrations from Original Designs engraved on Wood by G. Pearson. Crown 8vo, price 7s. 6d. cloth. [On Nov. 2.

INSECTS ABROAD: a Popular Account of Foreign Insects, their Structure, Habits, and Transformations With 600 Figures by E. A Smith and J. B Zwecker, engraved on Wood by G. Pearson. Forming a Sequel or Companion Volume to "Insects at Home" by the same Author. 8vo, price 21s. cloth. [On Nov. 2.

London: LONGMANS & CO.

Now ready, Fifth Edition, considerably Extended, with 40 Wood Engravings, Frontispiece, and 8 new Panoramic Maps, post 8vo, 12s. 6d.

WINTER and SPRING on the SHORES of the MEDITERRANEAN; or the Rivieras, Italy, Spain, Greece, Constantinople, the Archipelago, Corsica, Sicily, Sardinia, Algeria, Tunis, Smyrna, with Biarritz and Arcachon, as Winter Climates.

By DR. HENRY BENNET.

J. & A. CHURCHILL, New Burlington Street.

DR. LIONEL BEALE'S WORKS.

1. PROTOPLASM.—1. Dissentient. 2. Demonstrative. 3. Speculative. 16 Plates, 10s. 6d. Now ready, Third Edition. J. & A. CHURCHILL.
2. BIOPLASM, or LIVING MATTER. 16 Plates, 6s. 6d. J. & A. CHURCHILL.
3. DISEASE GERMS, and on the TREATMENT of the FEVERISH STATE. Second Edition. 28 Plates, 12s. 6d. J. & A. CHURCHILL.
4. KIDNEY DISEASES, URINARY DEPOSITS, and CALCULOUS DISORDERS Third Edition, 25s. J. & A. CHURCHILL.
5. The MYSTERY of LIFE: in Reply to Sir William Gull. 3s. 6d. J. & A. CHURCHILL.
6. The MICROSCOPE in MEDICINE. Fourth Edition much enlarged. J. & A. CHURCHILL. [In the Press.
7. HOW to WORK with the MICROSCOPE 21s. HARRISON, Pall Mall.

Now ready, price 5s. post-free.

The PROTOPLASMIC THEORY OF LIFE. An Inquiry into the Principles and Origin of Life, &c. By Dr. JOHN DRYSDALE, M.D. F.R.M S., President of the Liverpool Microscopical Society.

London: BAILLIERE, TYNDALL, & COX, King William Street, Strand.

BROWNING'S NEW "MINUTE" SPECTROSCOPE.

This Instrument, which is small enough to be worn as a pendant to a wat chain, measuring less than 2 inche length, yields a really fine spect when directed to a bright sky, and w show distinctly the bright lines of th metals, or the absorption bands in coloured liquids or transparent substances. Price 30s.

JOHN BROWNING,
Optical and Physical Instrument Maker
to the Royal Observatory and H.M.
Government,
63, Strand, London, W.C.
Established 100 Years.

DIARY OF SOCIETIES.

London

MONDAY, November 2.

Royal Institution, at 2.—General Monthly Meeting.

TUESDAY, November 3.

Zoological Society, at 8.30.—Report on the Recent Additions to the Society's Menagerie: The Secretary.—Exhibition of some Rhinoceros Horns obtained by Mr. Everett in Borneo: A. R. Wallace.—Liste des Oiseaux recueillis par M. Constantine Jelski dans la partie centrale du Perou occidental: M. L. Taczanowski.—On points in the Anatomy of the Parrots which bear on the Classification of the Sub-order: A. H. Garrod.

WEDNESDAY, November 4.

Geological Society, at 8.—Notes on the Comparative Microscopic Rock-structure of some Ancient and Modern Volcanic Rocks: J. Clifton Ward.—The Glaciation of the Southern Part of the Lake-district, and the Glacial Origin of the Lake-basins of Cumberland and Westmoreland; Second Paper: J. Clifton Ward.

Microscopical Society, at 8.—On some Himalayan Leaf-fungi: Dr. Fleming and M. C. Cooke.

Gresham Lecture, at 7.—On the Ear: Dr. E. S. Thompson.

THURSDAY, November 5.

Chemical Society, at 8.—On Methyl-hexyl Carbinol: Dr. C. Schorlemmer.—On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids: Dr. C. R. A. Wright.—Further Researches on Bilirubin and its Compounds: Dr. J. L. W. Thudichum.—Action of Bromine in the presence of Water on Bromopyrogallol and on Bromopyrocatechin: Dr. Stenhouse.

Linnean Society, at 8.—Revision of Asparagaceæ: J. G. Baker.—Monographic Sketch of the Duboisea: Dr. M. T. Masters.

Leeds

MONDAY, November 2.

Geological Association, at 8.—The Glacial Drift of the Neighbourhood of Leeds: J. H. Moore.

TUESDAY, November 3.

Naturalists' Field Club and Scientific Association, at 8.—Exhibition of Specimens and Conversation.

Torquay.

TUESDAY, November 2.

Natural History Society, at 12, noon.—Introductory Address, On Carcinology: Rev. T. R. R. Stebbing.

TO SECRETARIES OF SCIENTIFIC AND LITERARY SOCIETIES.

It having been suggested that the publication of a weekly Diary in Nature of the Meetings, &c. *of the various provincial* Scientific and Literary Societies *would be found very useful, not only to the Members of such Societies, but to all who are interested in Scientific and literary subjects, the Publishers have determined to devote a portion of their Advertisement columns to this purpose, and to insert* NOTICES OF MEETINGS, SUBJECTS OF LECTURES, *&c., at the nominal charge of* One Shilling *for each insertion.*

The Publishers of Nature *will be glad if the Secretaries of Societies will aid them in their endeavours to make this weekly Diary as complete and useful as possible. Notices intended for insertion therein must be sent, addressed to the* Publishers, *by* Wednesday Mornings.

Office—29, BEDFORD STREET, STRAND.

EVERY THURSDAY, PRICE 4*d.*

"*NATURE.*"

CHARGES FOR ADVERTISEMENTS.

Three lines in column, 2s. 6d.; 9d. per line after.

	£	*s.*	*d.*
One-eighth page, or quarter column	0	18	6
Quarter page, or half a column	1	15	0
Half a page, or a column	3	5	0
Whole page	6	6	0

Advertisements must be sent to the Office before 12 *o'clock on Wednesdays.*

Post-office Orders payable to Macmillan & Co.

OFFICE: BEDFORD STREET, STRAND, W.C.

This day is published, price 3*s.* 6*d.*
A Second Edition of

TABLES FOR TRAVELLERS.

ADAPTED TO THE POCKET OR SEXTANT CASE.
Compiled by ADMIRAL BETHUNE, C.B. and C.
WILLIAM BLACKWOOD & SONS, Edinburgh and London.

Third Edition, price 6*d.*

MODERN SCIENCE and NATURAL RELIGION: an Essay read before the Church Congress at Brighton, and now submitted to the Members of the British Association who listened to the Presidential Address at Belfast.

By Rev. C. PRITCHARD, M.A. F.R.S. F.G.S.,
Savilian Professor of Astronomy in the University of Oxford.

Oxford and London: JAMES PARKER & CO.
Cambridge: DEIGHTON, BELL, & CO., 1874.

THE ONLY CHEAP FARMERS' NEWSPAPER.

THE CHAMBER OF AGRICULTURE JOURNAL AND FARMERS' CHRONICLE,

Edited by John Algernon Clarke, Secretary to the Central Chamber of Agriculture,

Devotes special attention to the discussions and proceedings of the Chambers of Agriculture of Great Britain (which now number upwards of 18,000 members), besides giving original papers on practical farming, and a mass of intelligence of particular value to the agriculturist.

The London Corn, Seed, Hop, Cattle, and other Markets of Monday are specially reported in this Journal, which is despatched the same evening so as to insure delivery to country subscribers by the first post on Tuesday morning. Price 3*d.*, or prepaid, 15*s.* a year post free.

Published by W. PICKERING, 21, Arundel Street, Strand, W.C.

THE LINGUIST,

AND

EDUCATIONAL REVIEW:

A PLEASANT MONTHLY PERIODICAL (commencing 1st July, 1874), on the Languages, Antiquities, Scenery, Races, Creeds, and Legends of all Countries; containing also copious Reviews of New Publications—British and Foreign—Translations in Prose and Verse, and *thoroughly practical* Lessons in European and Oriental Languages. Twenty-four quarto pages. Price Sixpence. Obtainable through all Booksellers and Newsvendors in the United Kingdom, or direct from the Publishers, post-free, Sevenpence.

London: Thomas Cook and Son, Excursionists, Ludgate Circus, E.C., and 105, 106, and 107, Fleet Street, E.C.; Hodder and Stoughton, 27 and 31, Paternoster Row, E.C.

TISLEY'S PENDULUM APPARATUS,

	£	s.	d.
With Tracer, &c., for drawing Lissajous' Curves on Cards, or blackened Glass for the Lantern; packed in Deal Cabinet ...	£12	0	0
Reflectors for projecting the Figures on the Screen — —	2	12	6
N.B.—Specimen Curves, on card, post free — per dozen —	0	3	0
A Set of 30, including the principal Figures from 1 : 1 to 1 : 3 —	0	7	6
Ditto traced on blackened Glass, for the Lantern — per slide —	0	3	6

Educational Set of Acoustic Apparatus — —	**5**	**5**	**0**
Improved Ozone Generators — — . **21s. &**	**3**	**3**	**0**
Pocket Spectroscopes, with new Slit Adjustment — — — — — — — — —	**1**	**5**	**0**

TISLEY AND SPILLER,
OPTICIANS, &c.,
172, BROMPTON ROAD,
(Three minutes' walk from South Kensington Museum).

NEXT WEEK, medium 8vo. price 21*s.*

DEEP-SEA FISHING AND FISHING-BOATS.

An Account of the Practical Working of the various Fisheries around the British Islands; with Illustrations and Descriptions of the Boats, Nets, and other Gear in use.

BY EDMUND W. H. HOLDSWORTH, F.L.S., F.Z.S., &c.,
LATE SECRETARY TO THE ROYAL SEA FISHERIES COMMISSION.

London: EDWARD STANFORD, 6, 7, AND 8, CHARING CROSS, S.W.

MACMILLAN'S MAGAZINE.
FOR NOVEMBER.
PRICE 1*s.*

CONTENTS.

1.—"Sir Robert Peel and the Comte de Jarnac." By A. G. Stapleton, Esq.
2.—"Castle Daly: The Story of an Irish Home Thirty Years Ago." Chapters XXV.—XXVII.
3.—"Workhouse Schools for Girls." By Miss Smedley.
4.—"A Sacramental Hymn." By the Dean of Westminster.
5.—"The Oldest Fairy Tale in the World." With a Preface by Viscountess Strangford.
6.—"An Unnamed Habit of Language." By Rev. John Earle.
7.—"Notes on Rome." By Captain Richard F. Burton, F.R.G.S.—I. The Seven Hills.
8.—"Old Labels." By C. B.
9.—"Prussia and the Vatican." III. From 1850 to the Vatican Council.
10.—"Letter from the Archbishop of Westminster on 'Prussia and the Vatican' in the October Number."

MACMILLAN & CO., LONDON.

"THE GARDEN,"

A Weekly Illustrated Journal devoted solely to Horticulture in all its Branches.

"THE GARDEN" is conducted by WILLIAM ROBINSON, F.L.S., Author of "Hardy Flowers," "Alpine Flowers for English Gardens," "The Parks, Promenades, and Gardens of Paris," &c.; and the best Writers in every Department of Gardening are contributors to its pages.

The following are some of the subjects regularly treated of in its pages:—

The Flower Garden.
Landscape Gardening.
The Fruit Garden.
Garden Structures.
Room and Window Gardens.
Notes and Questions.
Market Gardening.
Trees and Shrubs.
Hardy Flowers.
Town Gardens.
The Conservatory.
Public Gardens.
The Greenhouse and Stove.
The Household.
The Wild Garden.
The Kitchen Garden.

"THE GARDEN" may be obtained through all Newsagents and at the Railway Bookstalls, at 4*d.* per Copy. It may also be had direct from the Office at 5*s.* for a Quarter, 9*s.* 9*d.* for a Half-year, and 19*s.* 6*d.* for a Year, payable in advance, and in Monthly Parts. Specimen Copies (post-free), 4½*d.*

37, Southampton Street, Covent Garden, W.C.

The Half Guinea Ale

Sound and Bright for Summer Use.

WALTHAM BROS., BREWERS, STOCKWELL.

On the 1st of every Month, pp. 32, 8vo, with at least One Plate,

THE JOURNAL OF BOTANY,
BRITISH AND FOREIGN,

Edited by HENRY TRIMEN, M.B., F.L.S., British Museum, assisted by J. G. BAKER, F.L.S., Royal Herbarium, Kew.

Subscriptions for 1874 (12*s.* post free in the United Kingdom) payable in advance to the publishers, Messrs. Ranken and Co., Drury House, St. Mary-le-Strand, London, W.C., of whom may be obtained the volume for 1873 (price 16*s.* 6*d.* bound in cloth); also covers for the volume (price 1*s.*), and back numbers.

"NATURE."

Nearly all the Back Numbers of NATURE may be obtained through any Bookseller, or of the Publishers, at the Office, 29, Bedford Street, Strand, W.C., to whom all communications relating to ADVERTISEMENTS should likewise be addressed.

Now ready, Vol. 9, bound in cloth, price 10*s.* 6*d.*

Cloth Cases for binding all the volumes, price 1*s.* 6*d.* each.

Reading Cases to hold 26 numbers, price 2*s.* 6*d.*

To be had through any bookseller or newsagent, or at the Office,

29, BEDFORD STREET, STRAND, W.C.

Price 14*s.*, with Woodcuts.

ETRUSCAN RESEARCHES. By Isaac TAYLOR, M.A. With Glossary and Index.

CONTENTS:—The Prologue—Tyrrhenians and Turanians—Ethnographical Notes on the Etruscan People—The Etruscan Mythology—The Etruscan Numerals—Epitaphs—Words denoting Kinship—The Bilingual Inscriptions—Forms of Dedication—The Ancient Vocabularies—Names—The Epilogue.

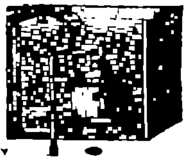
London: MACMILLAN & CO.

HOLLOWAY'S PILLS and OINTMENT.—Dyspepsia, Jaundice.—These complaints are the results of a disordered liver, which secretes bile in quality or quantity incapable of digesting food. Digestion requires a free flow of healthy bile, to promote which Holloway's Pills and Ointment have long been famous, far eclipsing any other medicine. Food, irregularity of living, unwholesome climates, and other causes, are constantly deranging the liver, but that important organ can, under all circumstances, soon be regulated and healthily adjusted by Holloway's Pills and Ointment, which directly control its vital secretion. The Ointment rubbed on the skin penetrates straight to the liver, the blood and nerves of which it speedily rectifies. One trial is all that is needed; a cure will soon follow.

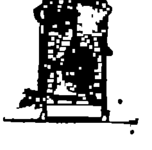
THE LONDON & GENERAL WATER PURIFYING COMPANY, LIMITED.

PATENT CISTERN FILTERS, CHARGED SOLELY WITH [illegible]NIMAL CHARCOAL, requiring, when once fixed, no attention whatever. And superior to all others. *Vide* Professor Fra[illegible] reports to the Registrar-General, July 1866, November 1867, and May 1870. See also the *Lancet*, Jan. 18, [illegible] Also Testimonials from Dr. Hassall, September 23, 1863, Dr Lankester, September 10, 1[illegible] February 15, 1865, and December 1872.

House Cistern, fitted with a Cistern Filter.



Portable Cistern Filter.



Price £1 10*s.* and upwards. Portable [illegible] his system, £1 5*s.* to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge; the *élite* of the Medical Profession; and at the London, St. George's, Fever, and German Hospitals, and at Government barracks and lunatic asylums, and numerous institutions, breweries, &c. Water Testing Apparatus, 10*s.* 6*d.* and 21*s.* each.

Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* DYKE on the Preliminary Duties of Health Officers.

Pocket Filters from 4*s.* 6*d.* to 6*s.* each. Household and Fancy Filters from 12*s.* 6*d.*

The Filters may be seen in operation, and full particulars obtained, on application to the Secretary, at the Office,

157, STRAND, W.C. (Four Doors from Somerset House), LONDON.

Read "Water: its Impurities and Purification," price, per post, 2*d.*

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

> "*To the solid ground*
> *Of Nature trusts the mind which builds for aye.*"—WORDSWORTH

No. 261, Vol. 10] THURSDAY, OCTOBER 29, 1874 PRICE FOURPENCE

Registered as a Newspaper at the General Post Office.

[All Rights are Reserved.

UNIVERSITY COLLEGE, LONDON.

THE THEORY OF EVOLUTION.—Prof. T WHARTON JONES, F R.S, will deliver a Lecture on this subject in the Botanical Theatre of the College on THURSDAY EVENING, the 29th inst., at 8 o'clock.

Admission free. Ladies are invited to attend

JOHN ROBSON, B.A., Secretary to the Council

October 23, 1874.

QUEENWOOD COLLEGE, near STOCKBRIDGE, HANTS.

Sound General Education for Boys.

Special attention to Science, particularly to Chemistry, both theoretical and practical.

References to Dr. Debus, F.R.S.; Dr. Frankland, F.R.S.; Dr. Roscoe, F.R.S.; Dr Angus Smith, F.R.S.; Dr. Tyndall, F.R.S; Dr. Voelcker, F.R.S., Dr. Williamson, F.R.S.

C. WILLMORE, Principal.

ROYAL COUNCIL OF EDUCATION.—The Laboratory and Class-rooms of Berners College are open for Pupils EVERY DAY and EVENING. The subjects of the above Examinations can be studied either Privately or in Classes. Fees moderate. Analyses and investigations conducted.—Apply to Prof E. V. GARDNER, F.E.S., F.S A., 44, Berners Street, W.

SUNDAY LECTURE SOCIETY.—LECTURES at ST GEORGE'S HALL, Langham Place, each SUNDAY AFTERNOON, at Four precisely. Sunday, November 1:—Prof W. K. CLIFFORD, M A (Camb.), F.R.S., on "Body and Mind."—Members' Annual Subscription, £1. Payment at the door—One Penny, Sixpence, and (reserved seats) One Shilling

LONDON LIBRARY,

12, ST. JAMES'S SQUARE.—Founded in 1841.

Patron—H.R.H. THE PRINCE OF WALES.

President—THOMAS CARLYLE, ESQ.

This Library contains 90,000 Volumes of Ancient and Modern Literature, in various Languages Subscription, £3 a year, or £2 with Entrance Fee of £6; Life Membership, £26.

Fifteen Volumes are allowed to Country, and Ten to Town Members Reading Room open from Ten to half-past Six. Prospectus on application. Catalogue, New Edition, in the press.

ROBERT HARRISON, Secretary and Librarian.

ELEMENTARY COLLECTIONS OF GEOLOGY and MINERALOGY from 10s. 6d. to 42s. Also more extensive ones upwards. Single Specimens, Hammers, Cabinets, Books, &c, of JAMES R. GREGORY, Mineralogist, 15, Russell Street, Covent Garden. Removing in December next to 88, Charlotte Street, Fitzroy Square, W.

PRELIMINARY EXAMINATIONS of the COLLEGE of SURGEONS and APOTHECARIES' HALL.—Mr. J ERLE BENHAM (formerly of King's College, London, author of several works), who has compiled, expressly for his own Pupils, Guides to the above, containing upwards of 400 questions and answers on all the subjects of examination, has CLASSES READING at his residence at Hampstead (where he receives a few resident Pupils) and in the Temple, for these Examinations For references to Noblemen, Members of Parliament, Doctors of eminence, Queen's Counsel, &c., address to 3, Pump Court, Temple, or to the care of Messrs. Butterworth, 7, Fleet Street, her Majesty's Publishers.

PREPARATION for the Public Schools by an Oxford M A. and First Classman. Natural Science included in the ordinary scheme of work.—Address J. L. WATSON, Esq, Richmond House, Worthing, Sussex.

GEOLOGY.—ELEMENTARY COLLECTIONS to illustrate the New Edition of "Lyell's Students' Elements of Geology," and facilitate the important study of this science, can be had at 2, 5, 10, 20, 50, to 1,000 guineas. Also, Single Specimens of Rocks, Minerals, Fossils, and Recent Shells. Geological Maps, Hammers, all the Recent Publications, &c, of J. TENNANT, Mineralogist to Her Majesty, 149, Strand, London.

Practical Instruction is given in Geology and Mineralogy by Professor TENNANT, F R.G S, at his residence, 149, Strand, W C.

MINERALS and ROCKS, Classified after Miller, Dana, and Rose. 100 Examples, 25s, 200 ditto, £2 10s to £3 10s; 300 ditto, £4 10s. to £6, 400 ditto, £6 to £8, 500 ditto, £8 8s to £10 10s. Including Half Fossils, 250 Examples, £3 10s 6d.; 400 ditto, £6. 150 FOSSILS illustrating Morris's Chart or Lyell's Manual, 30s; 250 ditto (mostly of the species figured), £3; 350 ditto £5 to £6. RECENT SHELLS: 100 genera, £1, 200 ditto, £2 10s

ALFRED BELL, 5, Grafton Street, Fitzroy Square, London.

Mr. C. H. LAKE (Graduate in Honour London) receives a limited number of RESIDENT PUPILS. Te monials from the late J. S. Mill, Dr. Tyndall, &c. Science rece careful attention.—Witherndon, Caterham, Surrey.

The REV. L. HENSLEY, Vicar of Hitchin, Herts, formerly Fellow and Assistant Tutor of Trinity College, C bridge, receives several Pupils, to prepare for the Universities an examinations, and has now Vacancies.

OR SALE. — BROWNING'S SL AUTOMATIC ELECTRIC LAMP, REFLECTOR, and TERN, £3. Also, PRISM on Brass Stand, by Ladd, £2.—A Dr. G. H. LOWE, County Analyst's Office, Lincoln

WANTED.—A SIDEREAL CLOCK OBSERVING CHAIR, and a DRIVING CLOCK, for an torial Telescope.—Address M.P, Pall Mall Club, S.W.

TRUSSES (Self-adjusting), in use for the last sixty years, and same as worn by his late Majesty William IV From 10s each. SALMON ODY & CO, by appointment to the Army and Navy, 292, Strand, London. Price List post free.

CHEST EXPANDER and TROUSERS BRACE combined, 8s.; Ladies' Chest Expanders from 5s. 6d — SALMON ODY & CO, 292, Strand, London. Established 1806.

ELASTIC STOCKINGS for Varicose Veins or Weak Joints; and LADIES' ABDOMINAL BELTS, made to any size. Directions for self-measurement and prices post free. SALMON ODY & CO., 292, Strand, London.

HAIR COLOUR WASH.—By damping the hair or whiskers with this beautifully perfumed Wash, in 24 hours the hair becomes its original colour, and remains so by an occasional using. 10s. 6d., sent for P.O order.—ALEX. ROSS, 248, High Holborn, London; and all Chemists.

NOSE MACHINE.—This is a contrivance which, applied to the nose for an hour daily, so directs the soft cartilage of which the member consists, that an ill-formed nose is quickly shaped to perfection. Anyone can use them, and without pain. Price 10s. 6d., sent carriage-free for P.O. order.—ALEX. ROSS, 248, High Holborn, London. Pamphlet sent for two stamps.

THOMAS D. RUSSELL,
GEOLOGIST & MICROSCOPIST,
48, ESSEX STREET, STRAND, W.C.
(Late of Arundel Street.)

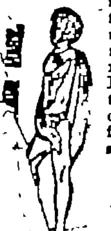
British Rocks—100 Specimens ... One Guinea.
British Fossils—100 " ... One Guinea.

Collections and Specimens of
British Fossils from the Crag to the Silurian inclusive.

Detailed Catalogues post-free.

RUPTURES.—BY ROYAL LETTERS PATENT.

WHITE'S MOC-MAIN LEVER TRUSS is allowed by upwards of 500 Medical Men to be the most effective invention in the curative treatment of Hernia. The use of a steel spring, so often hurtful in its effects, is here avoided; a soft bandage being worn round the body, while the requisite resisting power is supplied by the MOC-MAIN PAD and PATENT LEVER, fitting with so much ease and closeness that it cannot be detected, and may be worn during sleep. A descriptive circular may be had, and the Truss (which cannot fail to fit) forwarded by post, on the circumference of the body, 2 inches below the hips, being sent to the manufacturer,



JOHN WHITE, 228, Piccadilly.

Price of a Single Truss, 16s., 21s., 26s. 6d., and 31s. 6d.
" Double " 31s. 6d., 42s., and 52s. 6d.
" Umbilical " 42s. and 52s. 6d.
Post-free.

ASTIC STOCKINGS, KNEE-CAPS,
Varicose Veins and all cases of weakness and Swellings of the Legs, &c. They are porous, light in texture, and inexpensive, and drawn an ordinary stocking. Price 4s. 6d., 7s. 6d., 10s., and 16s. each.
ree.

N WHITE, Manufacturer, 228, Piccadilly, London.

W. LADD & CO.
SCIENTIFIC INSTRUMENT MANUFACTURERS
(By Appointment to the Royal Institution of Great Britain).
Spectroscopes, Microscopes, Polariscopes,
d every variety of Philosophical Apparat
& 12, BEAK STREET, REGENT STREET, W.,
AND
199, BROMPTON ROAD, S.W.

ESTABLISHED 1843.

NOTICE.—To Science Classes.—MOTTERSHEAD AND CO., LABORATORY FURNISHERS, EXCHANGE STREET, MANCHESTER, supply all the Apparatus enumerated in the SOUTH KENSINGTON LISTS FOR THE USE OF TEACHERS OF CHEMICAL OR PHYSICAL SCIENCE (including Light, Heat, Electricity, Magnetism, &c.), and will be happy to show intending purchasers specimens of the various Instruments, or to forward Estimates on application. Orders exceeding £2 in value delivered free to any railway station in England.

DRAPER'S INK (DICHROIC).

THE NEW BLACK INK
DIFFERING FROM ANYTHING ELSE EVER PRODUCED.

Writing becomes a pleasure when this Ink is used. It has been adopted by the principal Banks, Public Offices, and Railway Companies throughout Ireland.

It writes almost instantly Full Black.
Does not corrode Steel Pens
Is cleanly to use, and not liable to Blot.
Flows easily from the Pen.
Blotting-paper may be applied at the moment of writing.

TO BE HAD OF ALL STATIONERS.

FRY'S
VIENNA EXHIBITION
MEDAL FOR PROGRESS,
Awarded to J. S. FRY & SONS.

CARACAS
COCOA

Owes its delicious flavour to the choice Caracas and other Cocoas with which it is manufactured.

JUDSON'S DYES.—18 Colours, 6d. each

RIBBONS, WOOL, SILK, FEATHERS,

Completely dyed in 10 minutes without soiling the hands.

Full Instructions supplied. Of all Chemists and Stationers.

JUDSON'S DYES.—Dyeing at Home.—JUDSON'S simple DYES are most useful and effectual. Ribbons, silks, feathers, scarfs, lace, braid, veils, handkerchiefs, clouds, bernouses, Shetland shawls, or any small article of dress, can easily be dyed in a few minutes without soiling the hands, violet, magenta, crimson, mauve, purple, pink, ponceau, claret, &c.

JUDSON'S DYES.—Photographic Paper Positives or Photo-Prints should be dipped in hot water and then submitted to a hot bath of JUDSON'S DYES. Beautiful effects are thus produced in green, pink, brown, and many other colours—Use Judson's Dyes for general tinting. Dye your Cartes de Visite.

JUDSON'S DYES.—Ferns, Grasses, Flowers, and Sea-weeds may be dyed most exquisite colours, green, crimson, purple, scarlet, &c., by simply dipping them in a solution of JUDSON'S DYES. Charming Bouquet may be thus composed.

JUDSON'S DYES.—Ink—Ink—Ink.—A Sixpenny Bottle of JUDSON'S DYES, violet, red, or magenta, will make half a pint of brilliant writing ink in one minute by simply adding hot water.

JUDSON'S DYES.—For Colouring Architectural Plans, &c—Much trouble may be saved in grinding up colours to a uniform tint They may be used either with a brush or pen. Rose pink, purple, canary, crimson, orange, green, blue, magenta, and 12 other shades.

JUDSON'S DYES.—For Staining Wood.—Diluted with Water. They sink deeply into the fibre, and will not rub off They form the most economical stain on record. Light Brown for mahogany colour is excellent; No. 2 Black for walnut; Canary for satin; also black, lavender, magenta, and many other colours.

SIXPENCE PER BOTTLE,

Of Chemists and Oilmen in London, Chemists and Stationers in the Country.

Just ready, in Two Vols. 8vo, cloth extra, price 36s.

WITH MAPS, PORTRAITS, AND UPWARDS OF FIFTY FULL-PAGE ILLUSTRATIONS BY
ZWECKER AND DURAND.

ISMAILÏA:

A NARRATIVE OF
THE EXPEDITION TO CENTRAL AFRICA
FOR THE SUPPRESSION OF
THE SLAVE TRADE.

ORGANISED BY ISMAIL, KHEDIVE OF EGYPT.

SIR SAMUEL WHITE BAKER, PACHA, M.A., F.R.S., F.R.G.S., &c.

WITH A NEW PORTRAIT OF THE AUTHOR, ENGRAVED BY JEENS.

CONTENTS.

VOL. I.

CHAPTER I.—Introductory.
II.—English Party.
,, III.—The Retreat.
IV.—The Camp at Tewfikeeyah.
,, V.—Exploration of the old White Nile.
VI.—The Start.
,, VII.—Arrival at Gondokoro.
VIII.—Official Annexation.
IX.—New Enemies.
X.—Destruction of the Shir Detachment.
XI.—Spirit of Disaffection.
XII.—Vessels return to Khartoum.
XIII.—[illegible] results of the Hunt.

VOL. II.

CHAPTER I.—The Advance South.
,, II.—The Advance to Loboré.
,, III.—Arrival at Fatiko.
,, IV.—The March to Unyoro.
,, V.—March to Masindi.
,, VI.—Restoration of the liberated Slaves.
,, VII.—Establish Commerce.
,, VIII.—Treachery.
,, IX.—The March to Rionga.
,, X.—Build a Stockade at Foweera.
,, XI.—No Medical Men.
,, XII.—I send to Gondokoro for Reinforcements.
,, XIII.—Arrival of M'tésé's Envoys.
,, XIV.—Conclusion.
APPENDIX.
INDEX.

---

se two splendid volumes will well repay the utmost anxious curiosity with which the heir appearance. No enterprise of modern times has excited more interest than that ker undertook five years ago, and the story of the whole campaign told by himself chapter to the history of African adventure."

"It is a story of the utmost interest, and will take its place among the most English hardihood. . . . . For our own part, we shall not hesitate to affirm that and simple narrative as an undying honour to English literature, which nly and earnest deeds more eloquent than words. . . . . All through singularly effective pictures of native life and customs, each of the most

MACMILLAN & CO., LONDON.

E. DENT & CO., 61, Strand, & 34, Royal Exchange
(FACTORY, SAVOY ST.), LONDON.
MANUFACTURERS OF CHRONOMETERS, WATCHES, ASTRONOMICAL AND TURRET CLOCKS (with or without Galvanic Contact Apparatus), **COMPASSES**, &c.,
TO HER MAJESTY AND H.R.H. THE PRINCE OF WALES, AND H.I.M. THE EMPEROR OF RUSSIA.
MAKERS of the GREAT CLOCK of the HOUSES of PARLIAMENT.
MAKERS of the NEW STANDARD CLOCK of the ROYAL OBSERVATORY, Greenwich.
Catalogues or Estimates on Application.

SECURITY FROM FIRE AND THIEVES.
CHATWOOD'S "INVINCIBLE" SAFES
CAN ONLY BE HAD IN LONDON, AT THE DEPÔT,
120, CANNON STREET, E.C.

Chatwood's "Invincible" Safe Depôt is situate near King William's Statue, at the corner of Cannon Street and King William Street. A Price List containing full details of the construction of these Safes is forwarded post-free on application to SCOTT AND LIDDELL, Sole Agents. The list is Net Cash, and for quality cannot be equalled, comprising, as they do, the [illegible] quality with solid flange, lock case, and the frame, and the list 8 quality with intersected met[illegible]; curvilinear edge, claw-bolts, and gunpowder-proof unpickable lock. The only secure and reliable Safes sold, and, as proof thereof, is the only Safe made subject to Thirty-six [illegible] test with any kind of burglars' appliances before delivery.

PRIZE MEDALS.
Paris, 1867. Havre, 1868. Dublin, 1865. Oporto, 1868. Vienna, 1873.

120, CANNON STREET, LONDON, E.C.

"MAZELINE" GOLD JEWELLERY.
(Catalogue post free.)
18c. GOLD.—Superseded by the above imitation Jewellery—solid, durable, and cheap.
18c. GOLD.—Designs, beautifully copied in the above, and not to be detected from the precious metal.
18c. GOLD.—Jewellery, is reproduced in all the latest fashions (English, French, Swiss, Italian, &c.)

"MAZELINE" GOLD JEWELLERY,

Unequalled in appearance, fashion, wear, and design by any IMITATION YET offered to the public. It is solid, durable, and cheap, retaining [illegible] its 18c. gold appearance, which cannot be detected.

CASH PRICES.

Watches, 25s. to 45s. Alberts, 2s. to 5s.; Long Chains, 5s. to 8s. 6d.; Lockets, 2s to 5s. 6d.; Crosses, 1s. 6d. to 4s. 6d.; [illegible] 5s.; Wedding and Keeper Rings, 1s. to 2s. 6d.; Gents' Finger Rings, 2s. 6d. to 6s., Bracelets, 5s. to 10s 6d.: Studs, 1s. to 3s [illegible] Breast Pins, 1s to 4s. 6d; Brooches, 1s. 6d. to 7s. 6d; Ear Rings, 1s 6d. to 6s. 6d.: Sets (*en suite*), Brooch and Ear Rings, 5s [illegible] Cases, 2s to 4s 6d., Gents' Snake Rings (Plain Head), 3s. 6d, Head set with Brilliant, &c., 5s.

The Proprietors having devoted a large amount of capital and a length of time to the completion and production of the above, [illegible] and guarantee against all other competitors a superior, well-finished, and correct imitation of the precious metal, at prices within [illegible]

CAUTION.—Certain persons are endeavouring to imitate and foist upon the public an inferior and wretched article, and [illegible] we therefore beg to put the public on their guard against such deceptions.

N B.—Every watch is guaranteed for two years Names and Addresses should be distinctly and clearly [illegible]

Full-priced Catalogues and Press Opinions of the "**MAZELINE**" GOLD **JEWELLERY** to be ob[illegible]

MESSRS. MACMILLAN & CO.,
WHOLESALE AND RETAIL JEWELLERS AND ELECTROLINE MANU[illegible]
17, DEVONSHIRE SQUARE, BISHOPSGATE, LONDON, E.
P O O. to be made payable at Post Office, Bishopsgate Street Without, London, E.C.
AGENTS WANTED for the above throughout the United Kingdom. LIBERAL TERMS

L. OERTLING,
TURNMILL STREET, NEAR FARRINGDON STREE[illegible]
(LATE OF 27, MOORGATE STREET, CITY),
MANUFACTURER OF
CHEMICAL, ASSAY, AND BULLION BALA[illegible]
Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c
By Appointment.
Hydrometer and Saccharometer Maker to the Board of Inland Revenue.
Council Medal, 1851. *First Cl[illegible]*

Printed by R. CLAY, SONS, & TAYLOR, at 7 and 8, Bread Street Hill, in the City of London, and published [illegible] at the Office, 29 and 30, Bedford Street, Covent Garden.—THURSDAY, October 29, 1874.